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SELECTED WATER RESOURCES ABSTRACTS

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AUGUST 1989

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1989.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

ALTERNATIVE SOURCES OF LARGE SEASONAL GROUNDWATER SUPPLIES IN THE HEADWATER OF THE SUSQUEHANNA RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08319

NUMERICAL MODELING OF TIDE AND CIRCULATION IN CENTRAL PUGET SOUND: COMPARISON OF A THREE-DIMENSIONAL AND A DEPTH-AVERAGED MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W89-08352

SIMULATION OF QUANTITY AND QUALITY OF STORM RUNOFF FOR URBAN CATCHMENTS IN FRESNO, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08359

HYDROLOGIC DATA FOR INDIAN CREEK BASIN, FAYETTE AND WESTMORELAND COUNTIES, PENNSYLVANIA, 1985-87,
Geological Survey, Pittsburgh, PA. Water Resources Div.
J. I. Sams, and E. C. Witt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-469, July 1988. 133p, 3 fig, 27 tab, 4 ref.

Descriptors: *Mine drainage, *Water quality, Stream degradation, Basin study.

Hydrologic data were collected in the Indian Creek basin, Fayette and Westmoreland counties, Pennsylvania. Since the early 1900's, coal in the basin has been extensively mined by underground and surface mining techniques. Data collection sites are located in mined and unmined areas of the basin. The hydrologic data presented are from 5 continuous record surface water data collection sites, 1 groundwater well, 23 partial-record surface water sites and 2 continuous-record precipitation gages. Data from five continuous-record surface water sites include discharge, specific conductance, temperature, pH, and suspended-sediment concentration. Result of laboratory analyses of the sampling sites are reported. Benthic macroinvertebrates collected at 23 sites are listed. Maps of the area show the location of the data collection sites. (USGS)
W89-08379

EVALUATION OF THE FLOOD HYDROLOGY IN THE COLORADO FRONT RANGE USING PRECIPITATION, STREAMFLOW, AND PALEOFLOOD DATA FOR THE BIG THOMPSON RIVER BASIN,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08406

FIELD CONDITIONS AT THE MARICOPA AGRICULTURAL CENTER, MARICOPA AGRICULTURAL CENTER, MARICOPA COUNTY, ARIZONA, JUNE 13, 1988,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08423

FINITE-ELEMENT MODEL FOR SIMULATING HYDRAULIC INTERCHANGE OF SURFACE AND GROUNDWATER,
Geological Survey, Cheyenne, WY. Water Resources Div.
K. C. Glover.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 86-4319, 1988. 90p, 6 fig, 4 tab, 16 ref.

Descriptors: *Surface-groundwater relations, *Model studies, *Computer models, *Groundwater movement, Simulation analysis, Hydraulic models, Streamflow depletion, Wyoming, Computer programs.

A model was developed to be useful for predicting changes in streamflow as a result of groundwater pumping. The stream aquifer model is especially useful for simulating streams that flow intermittently owing to leakage to the aquifer or diversion for irrigation or streams that become perched owing to declining hydraulic head in the aquifer. The model couples the equation of two-dimensional groundwater flow with the kinematic equations of one-dimensional open-channel flow. Darcy's law for vertical flow through a semipermeable streambed is used to couple the groundwater flow and streamflow equations. The equations of flow are approximated numerically by the finite-element method. A listing of the Fortran program that solves the equations of flow, and a description of data-input formats are given in the report. The program can simulate a variety of hydrologic characteristics including perched streams, streamflow diversions, springs, recharge from irrigated acreage, and evapotranspiration from the water table and phreatophytes. Time-dependent boundary conditions can be simulated. The program can be modified easily to simulate unconfined aquifers and aquifers with variable directions of anisotropy. (USGS)
W89-08426

MODERN HYDROLOGY,
Louisiana State Univ., Baton Rouge.
R. G. Kazmann.
The National Water Well Association, Dublin, OH. 1988. 427p.

Descriptors: *Geohydrology, *Hydrology, *Hydrological regime, Precipitation, Evaporation, Surface water, Groundwater, Water resources development, History.

The sections on the four principal phases of the hydrologic cycle have been expanded in this third edition of this hydrology textbook to include the results of recent research. The introduction is concerned with definitions, a discussion of the hydrologic cycle, and the historical development of the general subject. Chapters individually discuss: precipitation, evaporation, surface water, groundwater, and water resources development. (Lantz-PTT)
W89-08465

INSTITUTE OF HYDROLOGY DISTRIBUTED MODEL,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W89-08483

CLASSIFICATION OF BOTTOM COMPOSITION AND BATHYMETRY OF SHALLOW WATERS BY PASSIVE REMOTE SENSING,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 7C.
W89-08601

RELATION BETWEEN GROUND-WATER AND SURFACE WATER IN THE HILLSBOROUGH RIVER BASIN, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky, and T. H. Thompson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4010, 1987. 58p, 18 fig, 6 tab, 39 ref.

Descriptors: *Surface-groundwater relations, *Geohydrology, *Florida, River basins, Rainfall, Evapotranspiration, Groundwater recharge, Aquifers, Groundwater depletion, Groundwater movement, Seepage, Hillsborough River, River basins.

The relation between groundwater and surface water in the Hillsborough River basin was defined through the use of: seismic-reflection profiling along selected reaches of the Hillsborough River, and evaluation of streamflow, rainfall, groundwater levels, water quality, and geologic data. Major municipal well fields in the basin are Morris Bridge and Cypress Creek where an averages of 15.3 and 30.0 million gal/day (mgd), respectively, were pumped in 1980. Mean annual rainfall for the study area is 53.7 inches. Average rainfall for 1980, determined from eight rainfall stations, was 49.7 inches. Evapotranspiration, corrected for the 5% of the basin that is standing water, was 35.7 in/year. The principal geohydrologic units in the basin are the surficial aquifer, the intermediate aquifer and confining beds, the Upper Floridan aquifer, the middle confining unit, and the Lower Floridan aquifer. Total pumpage of groundwater in 1980 was 98.18 mgd. The surficial aquifer and the intermediate aquifer are not used for major groundwater supply in the basin. Continuous marine seismic-reflection data collected along selected reaches of the Hillsborough River were interpreted to define the riverbed profile, the thickness of surficial deposits, and the top of persistent limestone. Major areas of groundwater discharge near the Hillsborough River and its tributaries are the wetlands adjacent to the river between the Zephyrhills gaging stations and Fletcher Avenue and the wetlands adjacent to Cypress Creek. An estimated 20 mgd seeps upward from the Upper Floridan aquifer within those wetland areas. The runoff/sq mi is greater at the Zephyrhills station than at Morris Bridge. However, results of groundwater flow models and potentiometric-surface maps indicate that groundwater is flowing upward along the Hillsborough River between the Zephyrhills gage and the Morris Bridge gage. This upward leakage is lost to evapotranspiration. An aquifer test conducted in 1978 at the Morris Bridge well field was evaluated by using an anisotropic method. Analytical results matched observed water levels within 0.1 ft. Analysis of aquifer test results indicates that withdrawals of up to 28 mgd would have a negligible effect on the river stage or flow. (Author's abstract)
W89-08627

RECONNAISSANCE OF THE GROUNDWATER, SURFACE WATER SYSTEM IN THE ZEKIAH SWAMP RUN BASIN, CHARLES AND PRINCE GEORGES COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08643

APPLICATION OF THE PRECIPITATION-RUNOFF MODELING SYSTEM TO SMALL BASINS IN THE PARACHUTE CREEK BASIN, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08652

HYDROLOGIC DATA FROM THE JOHNSON BROOK PHOSPHORUS LOADING STUDY, KENNEBEC COUNTY, MAINE, MARCH 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08656

GEOHYDROLOGY AND MODEL ANALYSIS OF STREAM-AQUIFER SYSTEM ALONG THE ARKANSAS RIVER IN KEARNY AND FINNEY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Re-

sources Div.
For primary bibliographic entry see Field 2E.
W89-08658

POSSIBLE CHANGES IN GROUND-WATER FLOW TO THE PECOS RIVER CAUSED BY SANTA ROSA LAKE, GUADALUPE COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08670

SURFACE-WATER HYDROLOGY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08678

(WATER RESOURCES MAPS OF THE REELFOOT STATE WILDLIFE MANAGEMENT AREA, REELFOOT LAKE AND IMMEDIATE ENVIRONS).
Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08716

ESTIMATION OF NATURAL GROUNDWATER RECHARGE.
For primary bibliographic entry see Field 2F.
W89-08830

RAINFALL-RUNOFF-RECHARGE RELATIONSHIPS IN THE BASEMENT ROCKS OF ZIMBABWE,
Hydrotechnica, Shrewsbury (England).
For primary bibliographic entry see Field 2F.
W89-08852

DESCRIPTION OF THE PHYSICAL ENVIRONMENT AND COAL-MINING HISTORY OF WEST-CENTRAL INDIANA, WITH EMPHASIS ON SIX SMALL WATERSHEDS,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. D. Martin, C. G. Crawford, R. F. Duwelius, and D. E. Renn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-212, 1987. 62p, 24 fig, 10 tab, 40 ref.

Descriptors: *Coal mining, *Environmental effects, *Watersheds, *Land use, *Coal mine effects, *Surface-groundwater relations, Indiana, Geology, Soil properties, Soil water, Mine drainage, Streamflow, Aquifers, Groundwater.

Information on the geology, geomorphology, soils, climate, hydrology, water use, land use, population, and coal mining history of Clay, Owen, Sullivan, and Vigo Counties in Indiana is summarized. Site-specific information is given on the morphology, geology, soils, land use, coal mining history, and hydrologic instrumentation of the six watersheds which are each less than 3 sq mi in area. The Wabash, White, and Eel Rivers are the major drainages in west-central Indiana. Average annual precipitation is about 39.5 in/yr and average annual runoff is about 13 in/yr. The most productive aquifers are confined or unconfined outwash aquifers located along the major rivers. Bedrock aquifers are regionally insignificant but are the sole source of groundwater for areas that lack outwash, alluvium, or sand and gravel lenses in till. Indiana has more than 17 billion short tons of recoverable coal reserves; about 11% can be mined by surface methods. Almost half of Indiana's surface reserves are in Clay, Owen, Sullivan, and Vigo Counties. More than 50,000 acres in west-central Indiana have been disturbed by surface coal mining from 1941 through 1980. Big Slough and Hooker Creek are streams that drain unmined, agricultural watersheds. Row-crop corn and soybeans are the principal crops. Soils are moderately well drained silt loams, and the watersheds well developed dendritic drainage systems. Unnamed tributaries drain mined and reclaimed watersheds. Ridges of mine spoil have been graded to a gently rolling topography. Soils are well drained and consist of 6 to 12 inches of silt-loam topsoil that was stockpiled and then replaced over shale and sandstone fragments of the graded mine spoil. Grasses and legumes form the vegetative cover in each watershed. Pond Creek and an unnamed tributary to Big Branch are streams that drain mined and unreclaimed watersheds. Soils are very well drained shaly silty loams that have formed on steeply sloping banks. Both watersheds contain numerous impoundments of water and have enclosed areas that do not contribute surface runoff to streamflow. The ridges of mine spoil are covered with pine trees, but much of the soil surface is devoid of vegetation. (Lantz-PTT)
W89-08987

OPERATION OF HYDROLOGIC DATA COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1987,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08996

RECHARGE OF SHALLOW AQUIFERS THROUGH TWO EPHEMERAL-STREAM CHANNELS IN NORTHEASTERN WYOMING, 1982-83,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09018

ANALYSIS OF SEDIMENT PRODUCTION FROM TWO SMALL SEMIARID BASINS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09020

HYDROLOGIC AND CLIMATOLOGIC DATA FOR THE LEHIGH AREA, SOUTHEASTERN OKLAHOMA, MAY 1977 TO JANUARY 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09062

HYDROLOGIC DATA FROM NAVAL OIL SHALE RESERVES, PARACHUTE CREEK BASIN, NORTHWESTERN COLORADO, 1980-81,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09076

HYDROLOGIC DATA FROM NAVAL OIL SHALE RESERVES, PARACHUTE CREEK BASIN, NORTHWESTERN COLORADO, 1980-81,
Geological Survey, Lakewood, CO. Water Resources Div.
K. C. Galyean, D. B. Adams, and D. L. Collins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-858, 1985. 70p, 4 fig, 26 tab, 3 ref.

Descriptors: *Hydrologic data collections, *Hydrologic data, *Parachute Creek, *Colorado, Surface water, Sediments, Water quality, Climatic data, Air temperature, Humidity, Wind, Precipitation, Snow.

Two years (water yr 1980 and 1981) of data collected by the U.S. Geological Survey for the U.S. Department of Energy, Naval Petroleum and Oil Shale Reserves, in the Parachute Creek drainage basin of northwestern Colorado are tabulated. Data were obtained from five surface water gages, two automatic sediment samplers, and two water quality monitors. Climate data include maximum, minimum, and average temperature and relative humidity, average wind speed and wind direction, and total daily solar radiation. Daily total precipitation is reported for three stations, and snow-course data reported for one site. (Author's abstract)
W89-09076

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1982,
Geological Survey, Lakewood, CO. Water Resources Div.
D. O. Rosenberry, A. M. Sturrock, J. L. Scarborough, and T. C. Winter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-89, 1988. 43p, 6 tab, 6 ref.

Descriptors: *Climatic data, *Williams Lake, *Hydrologic data collections, Minnesota, Hydrology, Evaporation, Water temperature, Air temperature, Wind, Precipitation, Radiation.

Research on the hydrology of Williams Lake, north-central Minnesota includes study of evaporation. Those climatic data needed for energy budget and mass transfer studies are presented, including: water surface temperature, dry-bulb and wet-bulb air temperatures, wind speed, precipitation, and solar and atmospheric radiation. Some calculated values necessary for these studies are also presented, such as vapor pressure and Bowen-ratio values. Data are collected at raft and land stations. (See also W87-09815) (Author's abstract)
W89-09201

WATER-RESOURCES ACTIVITIES IN OHIO, 1986.
Geological Survey, Columbus, OH. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-308, 1986. 2p, 1 fig, 1 ref.

Descriptors: *Water resources development, *Ohio, Data acquisition, Hydrologic data, Information exchange, Administration, Intergovernmental relations.

The Ohio District of the Water Resources Division, U.S. Geological Survey, provides information on Ohio's water resources for the overall benefit of the State and the Nation. An integral part of the Survey's mission is to conduct investigations of the Nation's land, mineral, and water resources, and to publish and disseminate the information needed to understand, to plan the use of, and to manage these resources. The activities fall into eight broad categories: collection of hydrologic data; water resources investigations and assessments; basic and problem-oriented hydrologic and water related research; acquisition of information useful in predicting and delineating water related natural hazards; coordination of the activities of all Federal agencies in the acquisition of water data, and operation of water information centers; dissemination of data and the results of investigations; provision of scientific and technical assistance in hydrologic studies; and the administration of the State Water Resources Research Institute Program and the National Water Resources Research Grant Program. (Lantz-PTT)
W89-09213

GEOLOGY, WATER MOVEMENT, AND SEDIMENT CHARACTERISTICS OF THE SPRING RIVER UPSTREAM FROM LA RUSSELL, SOUTHWESTERN MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09226

SUPPORTING DATA FOR ENVIRONMENTAL TRENDS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09227

CLIMATOLOGICAL DATA FOR THE RICE-GROWING AREAS ALONG THE NORTH COAST OF PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
A. Roman-Mas, and B. Green.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-53, 1987. 90p, 10 fig, 3 tab, 4 ref.

Descriptors: *Climatic data, *Data collections, *Agriculture, *Climatology, *Rice, *Puerto Rico, Cultivated lands, Data acquisition, Rainfall, Temperature, Wind velocity, Evaporation, Data interpretation, Measuring instruments.

Rainfall, temperature, wind velocity and pan evaporation data were collected from May 1983 to September 1985, in the rice growing areas of Vega Baja, Manati, and Arecibo in northern Puerto Rico. Daily values and statistics including mean, standard deviation, extremes, and totals for each month of record were compiled. Descriptions of equipment installation and operation, data processing, and significance of climatological data for rice cultivation are presented. (Author's abstract)
W89-09228

2B. Precipitation

MEAN ANNUAL PRECIPITATION MAP FOR IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7C.
W89-08343

GROUNDWATER-QUALITY-MONITORING PROGRAM IN IOWA: NITRATE AND PESTICIDES IN SHALLOW AQUIFERS,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08410

ACID SOIL AND ACID RAIN: THE IMPACT ON THE ENVIRONMENT OF NITROGEN AND SULPHUR CYCLING,
Sydney Univ. (Australia).
For primary bibliographic entry see Field 5C.
W89-08467

COMPOSITE, MESO-GAMMA SCALE DIAGNOSTIC MODELING,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W89-08499

FISHERIES-OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI) SURFACE METEOROLOGICAL OBSERVATIONS AT CHERNI ISLAND AND UGAIUSHAK ISLAND-FISCAL YEAR 1986,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
S. A. Macklin.
Available from the National Technical Information Service, Springfield, VA 22161. NOAA Data Report ERL PMEL-21, January 1988. 15p, 3 fig, 1 tab, 2 ref.

Descriptors: *Fisheries, *Oceanography, *Meteorology, *Data collections, *Alaska, *Cherni Island, *Ugaiushak Island, Winds, Barometric pressure, Temperature, Fish populations, Weather.

The data were collected in partial support of the Fisheries-Oceanography Coordinated Investigations (FOCI) to understand better the physical and biological causes of variations in abundance of fish and shellfish populations with an emphasis on recruitment and year-class phenomena. The long-range objective is to improve prediction of changes in abundance before recruitment to the fishable populations. The major field sampling activities, including remote weather station operations, conducted by FOCI during fiscal year 1986 (1 October 1985 through 30 September 1986) are summarized. This report presents times series of wind, temperature, and pressure collected at two sites in the FOCI research area-Cherni Island and Ugaiushak Island, Alaska. (Lantz-PTT)
W89-08501

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 5: EFFECTS OF ACID DEPOSITION ON SOILS IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
For primary bibliographic entry see Field 5C.
W89-08503

CORRELATION PROPERTIES OF RAINFALL RATES IN U.K.,
Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
H. Fukuchi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-145636, price codes: E04 in paper copy, E04 in microfiche. Report No. 398, August 1987. 19p, 2 fig, 1 tab, 10 ref.

Descriptors: *Statistics, *Correlation analysis, *Rainfall rate, *United Kingdom, Data interpretation, Spatial distribution, Seasonal variation, Statistical analysis, Mathematical analysis, Probability distribution.

Rainfall rate data acquired from the UK Meteorological Office were analyzed to obtain spatial correlation properties of rainfall rates at 23 locations in UK. The correlation coefficients of rainfall rates between locations are derived, and dependencies of separation distance, season and integration time on the coefficients are clarified. Conditional correlation coefficients obtained from rainfall rate data only larger than 1 mm/h at both locations simultaneously were obtained and related to the non-conditional coefficients. Joint probability distribution of rainfall rates at two locations are approximated by a bivariate log-normal distribution function, in which a modified correlation coefficient is used. (Author's abstract)
W89-08516

STATISTICAL STABILITY OF CUMULATIVE DISTRIBUTIONS OF RAINFALL RATE IN THE U.K.,
Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
H. Fukuchi, and P. A. Watson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-145875. Price codes: E03 in paper copy, A01 in microfiche. Report No. REPT-400, October 1987. 17p, 8 fig, 3 ref.

Descriptors: *Stability analysis, *Rainfall, *Statistical analysis, Rainfall rate, Rainfall distribution, Seasonal variation, Great Britain, Statistical studies, Probability distribution, Prediction.

By using the rainfall rate data measured at 10 typical locations which have nearly the same long-term cumulative distributions of rainfall rate, distributions of yearly and worst-month cumulative time percentages at several rainfall rate threshold levels are derived. The distributions of the yearly and the worst-month time percentages are approximated by the Gamma distribution and log-normal distribution, respectively. It is found that the parameters used in these distributions depend on the rainfall rate threshold level. By using this empirical result, a concept of a prediction risk is introduced. The dependence of the cumulative distribution on the risk is discussed. (Author's abstract)
W89-08522

CHEMICAL QUALITY OF PRECIPITATION AT GREENVILLE, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
J. A. Smath, and T. L. Potter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4037, 1987. 54p, 15 fig, 14 tab, 31 ref.

Descriptors: *Water quality, *Chemistry of precipitation, *Maine, *Water pollution sources, *Water analysis, *Acid rain, *Precipitation, *Organic compounds, *Trace metals, *Pollutant identification, Cadmium, Chromium, Copper, Lead, Mercury, Zinc, Nickel, Pesticides, Polychlorinated biphenyls, Sulfates, Nitrates.

Weekly composite precipitation samples were collected at a rural site located in Greenville, Maine for analysis of trace metals and organic compounds. Samples collected during February 1982, through May 1984, were analyzed for cadmium, chromium, copper, lead, mercury, nickel, and zinc and during February 1982, through March 1983, for chlorinated hydrocarbon pesticides, pthalate ester plasticizers, and polychlorinated biphenyls. Deposition rates were computed. Data reported by the NADP (National Atmospheric Deposition Program) was used to evaluate the general chemical quality of the precipitation. The precipitation had relatively high concentrations of hydrogen ions, sulfate, and nitrate, compared to other constituents. Of the trace metals included for analysis, only copper, lead, and zinc were consistently detected. Lead concentrations exceeded the U.S. EPA recommended limit for domestic water supply in three samples. High deposition rates for some of the metals were episodic. Alpha-hexachlorocyclohexane was the only organic compound that was consistently detected (maximum 120 nanograms/L). None of the other organic compounds were detected in any of the samples. (Author's abstract)
W89-08787

METHODS FOR ESTIMATION OF NATURAL GROUNDWATER RECHARGE DIRECTLY FROM PRECIPITATION-COMPARATIVE STUDIES IN SANDY TILL,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
For primary bibliographic entry see Field 2F.
W89-08845

MORE FREQUENT FLOODING IN LOUISIANA: CLIMATIC VARIABILITY,
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
For primary bibliographic entry see Field 2E.
W89-08867

RAINFALL-RUNOFF MODEL FOR AGRICULTURAL DRAINAGE IN THE EXPERIMENTAL STATION OF THE THREE-RIVER PLAIN IN HEILONGJIANG PROVINCE,
Water Conservancy Research Inst. of Heilongjiang Province, Harbin (China).
For primary bibliographic entry see Field 2E.
W89-08871

STATISTICAL METHODS OF DETERMINING TYPICAL WINTER AND SUMMER HYDROGRAPHS FOR UNGAUGED WATERSHEDS,
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
For primary bibliographic entry see Field 2E.
W89-08873

RESPONSE CHARACTERISTICS OF TWO TROPICAL RIVER BASINS,
Utsunomiya Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-08876

Group 2B—Precipitation

FLOOD OF APRIL 5-7, 1984, IN NORTHEASTERN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09134

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1982,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09201

CLIMATOLOGICAL DATA FOR THE RICE-GROWING AREAS ALONG THE NORTH COAST OF PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09228

FLOODS OF MAY 17-18, 1985 AND OCTOBER 6-7, 1985 IN PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09242

PATTERNS OF ACID DEPOSITION VARIABILITY IN THE EASTERN UNITED STATES, 1981-84,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09262

2C. Snow, Ice, and Frost

FLOODS OF MARCH 1982, FORT WAYNE, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08868

HYDROLOGIC HAZARDS ALONG SQUAW CREEK FROM A HYPOTHETICAL FAILURE OF THE GLACIAL MORAINE IMPOUNDING CARVER LAKE NEAR SISTERS, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08986

COLUMBIA GLACIER, ALASKA: PHOTOGRAMMETRY DATA SET: 1981-82 AND 1984-85,
Geological Survey, Tacoma, WA. Water Resources Div.
R. M. Krimmel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-219, 1987. 104p, 10 fig, 7 tab, 6 ref.

Descriptors: *Columbia Glacier, *Photogrammetry, *Data collections, *Aerial photography, *Glaciology, Remote sensing, Glaciation, Ice.

Photogrammetric processing of 12 sets of vertical aerial photography of the Columbia Glacier, Alaska, has measured the altitude and velocity fields of the lowest 14,000 m of the glacier during the periods of September 1981 to October 1982 and October 1984 to September 1985. The data set consists of the location of 3,604 points on the glacier, 1,161 points along the glacier terminus, and 1,116 points along the top of the terminus ice cliff. During the 1981 to 1985 period the terminus of the glacier receded 1,350 m, the ice near the terminus thinned at a rate of 18 m/year, and ice velocity near the terminus tripled, reaching as much as 6,000 m/year. (Author's abstract)
W89-08990

SHORT-TERM VELOCITY MEASUREMENTS AT COLUMBIA GLACIER, ALASKA: AUGUST-SEPTEMBER 1984,
Geological Survey, Tacoma, WA. Water Resources Div.
B. H. Vaughn, C. F. Raymond, L. A. Rasmussen, D. S. Miller, and C. A. Michaelson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-487, 1985. 29p, 7 fig, 2 tab, 12 ref, 2 append.

Descriptors: *Columbia Glacier, *Alaska, *Glaciers, *Velocity, Surveys, Ice, Glaciology, Glacier surges, Icebergs.

Ice velocity data are presented for the lower reach of Columbia Glacier, Alaska. The data span a 29 day period and contain 1,072 angle sightings from two survey stations to 22 markers placed on the ice surface, and 1,621 laser measurements of the distance to one of those markers (number 11) from another station. These short-interval observations were made to investigate the dynamics of the glacier and to provide input to models for estimation of future retreat and iceberg discharge. The mean ice velocity (at marker number 11) was approximately 9 m/day and ranged from 8 to < 15 m/day. The data set includes a well defined 2-day, 50% velocity increase and a clear pattern of velocity fluctuations of about 5% with approximately diurnal and semiurnal periods. (Author's abstract)
W89-09096

VELOCITY AND SURFACE ALTITUDE OF THE LOWER PART OF HUBBARD GLACIER, ALASKA, AUGUST 1978,
Geological Survey, Tacoma, WA. Water Resources Div.
R. M. Krimmel, and W. G. Sikonia.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-549, 1986. 13p, 4 fig, 6 tab, 3 ref.

Descriptors: *Glaciers, *Geomorphology, *Glaciology, *Hubbard Glacier, *Alaska, Glacial surges, Aerial photography.

The terminus position and locations of numerous points on the lower part of Hubbard Glacier were determined from 1:58,000 scale vertical aerial photographs taken July 30, 1978 and August 23, 1978. The same surface features were located on each set of photography, allowing displacement during the time interval to be measured. Velocity of the lower glacier for the 24-day interval was about 7 m/day. The terminus receded 45 m between the two dates. (Author's abstract)
W89-09112

COLUMBIA GLACIER IN 1986: 800 METER RETREAT,
Geological Survey, Tacoma, WA. Water Resources Div.
R. M. Krimmel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-207, 1987. 7p, 2 fig, 11 ref.

Descriptors: *Glacier balance, *Columbia Glacier, *Glaciers, Alaska, Ablation, Icebergs.

Columbia Glacier, in Prince William Sound, Alaska, continued its rapid retreat in 1986, with a retreat of 800 m. Average velocity of the lower portion of the glacier, 10 September 1986 to 26 January 1987, was three km/yr, or about one-half of the velocity during similar periods for the previous three years. This reduced velocity is a new development in the progression of the retreat, and if the calving rate follows the pattern of previous years, will result in continued retreat. (Author's abstract)
W89-09244

2D. Evaporation and Transpiration

ESTIMATES OF CONSUMPTIVE USE AND GROUNDWATER RETURN FLOW USING WATER BUDGETS IN PARKER VALLEY, ARIZONA, AND CALIFORNIA, 1981-84,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08428

APPLICATION OF MULTISPECTRAL SCANNING REMOTE SENSING IN AGRICULTURAL WATER MANAGEMENT PROBLEMS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W89-08575

POTENTIAL OF NUMERICAL AGRONOMIC SIMULATION MODELS,
Centre for World Food Studies, Wageningen-Amsterdam, The Netherlands.
For primary bibliographic entry see Field 7C.
W89-08606

EVAPORATION IN ARID AND SEMI-ARID REGIONS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Physics and Meteorology.
H. A. R. de Bruin.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 73-88, 4 fig, 34 ref, append.

Descriptors: *Evaporation, *Evapotranspiration, *Semiarid climates, *Satellite technology, Arid climates, Vegetation effects, Temperate zone, Advection, Infrared imagery, Remote sensing, Mathematical models.

Meteorological aspects of evaporation in arid and semi-arid regions are discussed and compared with those of temperate climates. The Penman-Monteith equation describes most aspects of evaporation of temperate crops. However, since semi-arid regions are seldom covered completely by vegetation, the Penman-Monteith equation cannot be applied in these areas. Remote sensing technology has been successfully applied on a regional scale in semi-arid regions. Temperate and semi-arid regions differ in evaporation, precipitation and vegetation cover. An eddy- correlation technique for the determination of total evaporation has been used in Niger. The physical processes related to soil evaporation and soil heat flux appear to be very complicated and are not yet fully understood. Menenti (1984) studied the evaporation in desert areas called playas, where groundwater reaches the surface, and presented a modification of the Penman-Monteith equation, introducing a resistance for water vapor transport for the soil layer between the surface and the water table. More research is required on evaporation from bare soils, an important process in semi-arid and arid zones. Some micrometeorological aspects affecting evaporation in semi-arid regions are: roughness length and zero-plane displacement, stability effects, net radiation, and advection. Difficulties in direct measurements in semi-arid regions may be overcome by use of the Bowen ratio method, and the eddy-correlation method. Soil moisture measurements can be made by passive radiometry or active RADAR microwave techniques. Because in semi-arid regions precipitation determines evaporation to a great extent, the infrared imagery methods of rainfall rate may be useful in estimates of evaporation. (See also W89-08830) (Geiger-PTT)
W89-08835

EVAPOTRANSPIRATION ESTIMATES USING REMOTE-SENSING DATA, PARKER AND PALO VERDE VALLEYS, ARIZONA AND CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
L. H. Raymond, and K. V. Rezin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-67, 1986. 33p, 6 fig, 7 tab, 16 ref.

Descriptors: *Evapotranspiration, *Remote sensing, *Data interpretation, *California, *Satellite technology, *Phreatophytes, *Arizona, *Water use, Data acquisition, Crops, Aerial photography, Landsat.

In 1981 the U.S. Geological Survey established an experimental project to assess the possible and practical use of remote sensing data to estimate evapotranspiration as an approximation of consumptive use in the lower Colorado River flood plain. The project area was in Parker Valley, Arizona. The approach selected was to measure the areas covered by each type of vegetation using remote sensing data in various types of analyses and to multiply each area by a predetermined water use rate. Two calibration and six remote sensing methods of classifying crop types were compared for cost, accuracy, consistency, and labor requirements. Included were one method each for field reconnaissance using 1982 data, low altitude (< than 5,000 ft) aerial photography using 1982 data, and visual photointerpretation of Landsat satellite images using 1981 and 1982 data; two methods for medium-altitude (15,000-18,000 ft) aerial photography using 1982 data; and three methods for digital Landsat satellite images using 1981 data. A test of the most promising digital processing method, which used three image dates, was made in part of Palo Verde Valley, California, where 1981 crop data were more complete than in Parker Valley. Of the eight methods studied, the three-date digital processing method was the most consistent and least labor-intensive; visual photointerpretation of Landsat images was the least expensive. Evapotranspiration estimates from crop classifications by all methods differed by a maximum of 6%. Total evapotranspiration calculated from crop data and phreatophyte maps in 1981 ranged from 12% lower in Palo Verde Valley to 17% lower in Parker Valley than consumptive use calculated by water budgets. The difference was greater in Parker Valley because the winter crop data were not included. (Author's abstract)
W89-09110

ESTIMATES OF EVAPOTRANSPIRATION IN ALKALINE SCRUB AND MEADOW COMMUNITIES OF OWENS VALLEY, CALIFORNIA, USING THE BOWEN-RATIO, EDDY-CORRELATION, AND PENMAN-COMBINATION METHODS,
Geological Survey, Sacramento, CA. Water Resources Div.
L. F. W. Duell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-92, 1988. 78p, 26 fig, 7 tab, 56 ref, append.

Descriptors: *Evapotranspiration, *Mathematical studies, *California, *Phreatophytes, Hydrologic budget, Diffusion, Regression analysis, Semiarid lands.

In Owens Valley, evapotranspiration (ET) is one of the largest components of outflow in the hydrologic budget and the least understood. ET estimates for December 1983 through October 1985 were made for seven representative locations selected on the basis of geohydrology and the characteristics of phreatophytic alkaline scrub and meadow communities. The Bowen-ratio, eddy-correlation, and Penman-combination methods were used to estimate ET. The results of the analyses appear satisfactory when compared to other estimates of ET. Results by the eddy-correlation method are for a direct and a residual latent-heat flux that is based on sensible-heat flux and energy budget measurements. Penman-combination potential ET estimates were determined to be unusable because they overestimated actual ET. Modification in the psychrometer constant of this method to account for differences between heat-diffusion resistance and vapor-diffusion resistance permitted actual ET to be estimated. The methods may be used for studies in similar semiarid and arid rangeland areas in the Western United States. Meteorological data for three field sites are included in the appendix. Simple linear regression analysis indicates that ET estimates are correlated to air temperature, vapor-density deficit, and net radiation. Estimates of annual ET range from 300 mm at a low-density scrub site to 1,100 mm at a high-density meadow site. The monthly percentage of annual ET was determined to be similar for all sites studied. (Author's abstract)
W89-09202

2E. Streamflow and Runoff

STREAMFLOWS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
H. W. Lowham.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 88-4045, 1988. 78p, 19 fig, 7 tab, 27.

Descriptors: *Water resources data, *Hydrologic data, *Data collections, *Streamflow, *Wyoming, Stream gages, Design floods, Flood peak, Flood frequency, Rainfall, Runoff.

A description of the occurrence and availability of surface waters in Wyoming is presented along with explanations of both streamflow-data collection and methods for estimating streamflow characteristics at gaged and ungaged sites. Mountain ranges separate the major drainage basins and have a significant effect on the quantity of precipitation and the volume of runoff that occurs in Wyoming. Perennial streams that originate in the mountains provide the most dependable source of runoff; streams that originate in the plains and deserts generally are intermittent or ephemeral and have extended periods of no flow. Streamflow data for several hundred gaged sites in the State are available for engineering and management purposes. When gaged data are not available, methods for estimating streamflow characteristics are needed. Methods presented in this report for estimating streamflow characteristics have been improved over previous methods through the use of refined analytical techniques and an updated data base. Peak-flow characteristics and mean annual runoff at ungaged sites can be estimated by using regression equations, with either basin characteristics or channel width being independent variables. Log-linear regression equations are used for estimating streamflow characteristics in the mountains; whereas, curvilinear equations of double-exponential form were determined to be more appropriate than log-linear relations for depicting peak flows in the plains and deserts. (USGS)
W89-08353

USER'S GUIDE FOR RIV2 - A PACKAGE FOR ROUTING AND ACCOUNTING OF RIVER DISCHARGE FOR A MODULAR, THREE-DIMENSIONAL, FINITE-DIFFERENCE, GROUNDWATER FLOW MODEL,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. S. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-345, December 1988. 33p, 4 ref.

Descriptors: *Groundwater movement, *Computer programs, *Routing, *Model studies, *Surface-groundwater relations, Streamflow, Flow models.

RIV2 is a package for the U.S. Geological Survey's modular, three-dimensional, finite-difference, groundwater flow model developed by M. G. McDonald and A. W. Harbaugh that simulates river-discharge routing. RIV2 replaces RIV1, the original river package used in the model. RIV2 preserves the basic logic of RIV1, but better represents river-discharge routing. The main features of RIV2 are (1) The river system is divided into reaches and simulated river discharge is routed from one node to the next. (2) Inflow (river discharge) entering the upstream end of a reach can be specified. (3) More than one river can be represented at one node and rivers can cross, as when representing a siphon. (4) The quantity of leakage to or from the aquifer at a given node is proportional to the hydraulic-head difference between that specified for the river and that calculated for the aquifer. Also, the quantity of leakage to the aquifer at any node can be limited by the user and, within this limit, the maximum leakage to the aquifer is the discharge available in the river. This feature allows for the simulation of intermittent rivers and drains that have no discharge routed to their upstream reaches. (5) An accounting of river discharge is maintained. Neither stage-discharge relations nor storage in the river or river banks is simulated. (USGS)
W89-08354

SIMULATION OF QUANTITY AND QUALITY OF STORM RUNOFF FOR URBAN CATCHMENTS IN FRESNO, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08359

INDEX OF SURFACE WATER STATIONS IN TEXAS, JANUARY 1988,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08384

EXTENSION OF STREAMFLOW AND DISSOLVED-SOLIDS RECORDS AT SELECTED SITES IN THE COLORADO RIVER BASIN, ARIZONA, CALIFORNIA, COLORADO, NEVADA, NEW MEXICO, UTAH, AND WYOMING, 1940-85,
Geological Survey, Denver, CO. Water Resources Div.
D. K. Mueller, and T. D. Liebermann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4203, July 1988. 74p, 19 fig, 18 tab, 10 ref. USGS project C0181.

Descriptors: *Streamflow, *Dissolved solids, *Statistical methods, *Hydrologic data, *Streamflow forecasting, *Colorado River, Western U.S, Surface-water data.

Monthly streamflow and dissolved-solids concentration were estimated for periods prior to the initiation of data collection at selected sites in the Colorado River basin. Techniques used for this record extension included simple and weighted least-squares regression. Streamflow records were extended at 5 sites and dissolved-solids records were extended at 13 sites. Records were extended back through 1941 to provide a completely concurrent data set for all sites. Standard errors were 5 to 74% for monthly streamflow and 3 to 27% for monthly, flow-weighted dissolved-solids concentration. The extended records at all sites were consistent with records from the historical period. (USGS)
W89-08398

IMPACTS OF IRRIGATION ON INSTREAM FLOW QUANTITY: PART I. WISFOM, THE WELL IMPACT ON STREAM FLOW MODEL, AND PART II. AN ANALYTICAL MODEL DETERMINATION OF VOLUME AND RATE OF STREAM DEPLETION BY INTERMITTENTLY PUMPING WELLS,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
R. B. Wallace, H. Soeryantono, Y. Darama, and M. D. Annable.
Available from National Technical Information Service, Springfield, VA 22161, as PB89-155634/AS, price codes: A06 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing, Technical Report No. G1429-05, April 1988. 93p, 26 fig, 4 tab, 5 ref. USGS contract 14-08-0001-G1429. USGS project G1429-05.

Descriptors: *Model studies, *Computer models, *WISFOM, *Instream flow, *Consumptive use, *Well pumping, *Surface-groundwater relations,

Planning, Algorithm, Groundwater, Michigan, Great Lakes, Irrigation, Instream water use.

Well pumping for irrigation and other long term groundwater use removes water from groundwater storage and alters the water flux across aquifer boundaries. WISFOM is a computer model which approximates the influence of groundwater pumping on stream flow based on Jenkin's (1968) equation. The simplifications that have been incorporated into the computer's algorithm are: (1) WISFOM introduced the impact of pumping at a point on the river path rather than representing it as spatially distributed along a reach on the river; and (2) There are no time delays on the stream system. Once a digitized map of the watershed that includes the stream path is available, WISFOM can be used interactively to integrate the watershed characteristic with the pumping network that may consist of up to 100 well points. The computation included depletion rate and volume for each pump, reduction in flow rate and volume for the points in the river. Hydrologic information is needed to clarify the significance of increased use of irrigation in Michigan and the Great Lake area. This information will help establish a mechanism for managing the development of consumptive water use to allow optimal use of water for irrigation while minimizing reduction of summer baseflows that are critical to instream water uses (biological, recreation, waste disposal). The primary objective is the development and application of an impact assessment model that can be used to evaluate the reduction in baseflow that accompanies increased use of supplemental irrigation. (USGS)
W89-08402

EVALUATION OF THE FLOOD HYDROLOGY IN THE COLORADO FRONT RANGE USING PRECIPITATION, STREAMFLOW, AND PALEOFLOOD DATA FOR THE BIG THOMPSON RIVER BASIN,
Geological Survey, Denver, CO. Water Resources Div.
R. D. Jarrett, and J. E. Costa.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 87-4117, 1988. 37p, 9 fig, 7 tab, 40 ref.

Descriptors: *Floods, *Flood frequency, *Paleohydrology, *Probable maximum precipitation, *Probable maximum flood, *Rainfall-runoff relationships, Design floods, Flood plain management, Dams, Discharge frequency, Geomorphology.

A multidisciplinary study of precipitation and streamflow data and paleohydrologic studies of channel features was made to analyze the flood hydrology of foothill and mountain streams in the Front Range of Colorado, with emphasis on the Big Thompson River basin, because conventional hydrologic analyses do not adequately characterize the flood hydrology. In the foothills of Colorado, annual floodflows are derived from snowmelt at high elevations in the mountain regions, from rainfall at low elevation in the plains or plateau regions, or from a combination of rain falling on snow or mixed population hydrology. Above approximately 7,500 ft, snowmelt dominates; rain does not contribute to the flood potential. Regional flood-frequency relations were developed and compared with conventional flood-estimating technique results, including an evaluation of the magnitude and frequency of the probable maximum flood. Evaluation of streamflow data and paleoflood investigations provide an alternative for evaluating flood hydrology and the safety of dams. The study indicates the need for additional data collection and research to understand the complexities of the flood hydrology in mountainous regions, especially its effects on flood-plain management and the design of structures in the flood plain. (USGS)
W89-08406

HYDROLOGY OF THE U.S. ARMY PINON CANYON MANEUVER SITE, LAS ANIMAS COUNTY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
P. von Guerard, P. O. Abbott, and R. C. Nickless.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4227, 1987. 117p, 43 fig, 26 tab, 53 ref.

Descriptors: *Colorado, *Water resources data, *Sediment yield, *Geology, *Groundwater, *Surface water, *Water quality, Flood frequency, Dissolved solids, Suspended sediment, Loads, Purgatoire River basin, Pinon Canyon.

The U.S. Department of the Army (Fort Carson Military Reservation) has acquired 381 sq mi of semiarid rangeland in southeastern Colorado for mechanized military maneuvers. The study area, known as the Pinon Canyon Maneuver Site, drains into the Purgatoire River, a major tributary of the upper Arkansas River. A multidisciplined hydrologic investigation began in October 1982. The primary aquifer in the Maneuver Site is the Dakota-Purgatoire. Well yields generally range from 10 to 500 gai/min. Dissolved solids concentrations in groundwater ranged from 195 to 6,150 mg/L. Streamflow in the Purgatoire River is perennial. Tributaries draining the Maneuver Site are intermittent or ephemeral and contribute only about 4.4% of the streamflow of the Purgatoire River downstream from the Maneuver Site. Flood frequencies were calculated by using the log Pearson III procedure and compared well with a regional estimating technique that was developed that uses physical drainage-basin characteristics. Calcium and sulfate are the predominant ions in the surface water of the area. Time-series plots indicate that instream water-quality standards for nitrate and metals are exceeded. About 80% of the suspended-sediment load is transported by rainfall runoff, which occurs less than 8% of the time. Ephermal tributaries contributed less than 25% of the suspended-sediment load transported to the Purgatoire River downstream from the Maneuver Site. Historic annual mean sediment yields were measured for 29 small watersheds. Sediment yields were measured for 29 small watersheds. Sediment yields ranged from 9.5 to 1,700 tons/sq mi. Sediment yields were estimated by a multiple-linear-regression model developed by using physical drainage-basin characteristics and by the Pacific Southwest Interagency Committee method. (USGS)
W89-08407

METHODS TO DETERMINE TRANSIT LOSSES FOR RETURN FLOWS OF TRANSMOUNTAIN WATER IN FOUNTAIN CREEK BETWEEN COLORADO SPRINGS AND THE ARKANSAS RIVER, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
G. Kuhn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4119, June 1988. 278p, 41 fig, 27 tab, 29 ref.

Descriptors: *Bank storage, *Surface-groundwater relations, *Channel storage, *Evaporation, *Model studies, *Imported water, *Return flow, *Colorado, Fountain Creek, Water management, Water exchange, Hydrologic models, Simulation.

Methods were developed by which transit losses could be determined for transmountain return flows in Fountain Creek between Colorado Springs, Colorado, and its confluence with the Arkansas River. The study reach is a complex hydrologic system wherein a substantially variable streamflow interacts with an alluvial aquifer. The study approach included: (1) calibration and verification of a streamflow-routing model that contained a bank-storage-discharge component; (2) use of the model to develop the methods by which transit losses could be calculated; and (3) design of an application method for calculating daily transit loss using the model results. Sources of transit losses that were studied are bank storage, channel storage, and evaporation. Magnitude of bank-storage loss primarily depends on duration of a recovery period during which water lost to bank storage is returned to the stream. Net loss to bank storage can vary from about 50% for a 0-day recovery period to about 2% for a 180-day recovery period. Virtually all water lost to bank storage could be returned to the stream with longer recovery periods. Channel-storage loss was determined to be about 10% of a release quantity. Because the loss on any given day is totally recovered in the form of gains from channel storage on the subsequent day, channel storage is a temporary transit loss. Evaporation loss generally is less than 5% of a given daily transmountain return-flow release, depending on month of year. Evaporation losses are permanently lost from the system. (USGS)
W89-08412

HISTORY OF SUSPENDED SEDIMENT DATA COLLECTION AND INVENTORY OF AVAILABLE DATA FOR THE TENNESSEE AND CUMBERLAND RIVER BASINS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08416

USE AND AVAILABILITY OF CONTINUOUS STREAMFLOW RECORDS IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08429

FLOODFLOW CHARACTERISTICS OF WYOMING STREAMS-A COMPILATION OF PREVIOUS INVESTIGATIONS,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. A. Druse, H. W. Lowham, M. E. Cooley, and A. M. Wacker.
Available from Wyoming Highway Dept. P.O. Bod 1708, Cheyenne, WY 82002. Wyoming Highway Department State Cooperative Report, 1988. 498p, 11 tab, 10 fig, 42 ref. USGS project WY010.

Descriptors: *Wyoming, *Flood data, *Flood flow, *Flood frequency, *Flood hydrographs, *Flood peak, Channel morphology, Flow characteristics, Hydrographs, Historic floods, Hydraulic design, Hydraulic structures, Hydrologic properties, Streamflow gages, Streamflow, Stream.

Investigations of hydrologic and hydraulic problems associated with floodflows were started during 1958 in cooperation with the Wyoming Highway Department and the Federal Highway Administration. The flood-investigations project developed methods to estimate the magnitude and frequency of floods. Annual maximum discharges were determined during the data-collection period (1959-84) at a maximum of 48 crest-stage stations. The inflow-hydrograph project was started during 1964 to develop methods to estimate the magnitude and frequency of flood volumes and maximum discharges for drainage basins less than 11 sq mi and to estimate their relation to each other. A maximum of 50 stage-rainfall stations was operated during the data-collection period, and precipitation-discharge data were compiled for 392 rainfall-runoff events. A mean-dimensionless hydrograph was developed for nonmountainous areas using 298 hydrographs from 28 basins. Methods developed from these studies aid in the evaluations of floods and in the optimum design for drainage structures. The data collected (annual maximum discharges, basin and channel characteristics, and flood magnitude and frequency) and methods developed are presented in the report. Additionally, this report is formatted to include results from subsequent investigations. (USGS)
W89-08450

HYDROLOGY OF THE FLORAL CITY POOL OF TSALA APOPKA LAKE, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08455

BASIC HYDRAULIC PRINCIPLES OF OPEN-CHANNEL FLOW,
Geological Survey, Reston, VA. Water Resources Div.
H. E. Jobson, and D. C. Froehlich.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-707, 1988. 150p, 38 fig, 8 tab, 24 ref.

Descriptors: *Open-channel flow, *Hydraulic engineering, *Streamflow, *Gaging, Continuity equation, Indirect flood measurement, Roughness coefficient, Steady flow.

The three basic principles of open-channel-flow analysis--the conservation of mass, energy, and momentum--are derived, explained, and applied to solve problems of open-channel flow. These principles are introduced at a level that can be comprehended by a person with an understanding of the principles of physics and mechanics equivalent to that presented in the first college level course of the subject. The reader is assumed to have a working knowledge of algebra and plane geometry as well as some knowledge of calculus. Once the principles have been derived, a number of example applications are presented that illustrate the computation of flow through culverts and bridges, and over structures, such as dams and weirs. Because resistance to flow is a major obstacle to the successful application of the energy principle to open-channel flow, procedures are outlined for the rational selection of flow resistance coefficients. The principle of specific energy is shown to be useful in the prediction of water-surface profiles both in the qualitative and quantitative sense. (USGS)
W89-08456

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08458

INSTITUTE OF HYDROLOGY DISTRIBUTED MODEL,
Institute of Hydrology, Wallingford (England).
K. Beven, A. Calver, and E. M. Morris.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-222468. Price codes: E05 in paper copy, E04 in microfiche. December 1987. 33p, 11 fig, 4 tab, 53 ref.

Descriptors: *Hydrologic models, *Model studies, *Overland flow, *Infiltration, Groundwater movement, Flow profiles, Channel flow, History, Mathematical models, Mathematical studies, Finite element method, Computer programs.

A physically-based catchment model for overland flow, saturated and unsaturated subsurface flow and channel flow is described. The history of the model's development is outlined and subsequent attention is focused on the most recent version, the IHDM4. The concepts of catchment representation and overall model structure are discussed. Detail is then provided on the individual model subroutines, covering the finite difference overland and channel flow solution and the finite element subsurface solution. (Author's abstract)
W89-08483

STORM EVENT SAMPLING OF TWO LOW ALKALINITY SOUTHWESTERN ARKANSAS STREAMS,
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
J. F. Nix, K. W. Thornton, D. E. Ford, and J. Malcolm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-225107, price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/023, June 1988. 239p, 46 fig, 16 tab, 63 ref, 2 append. EPA Contract CR811863.

Descriptors: *Acid rain effects, *Arkansas, *Alkalinity, *Saline River, Sulfates, Water pollution effects, Hydrogen ion concentration, Calcium, Sodium, Seasonal variation, Nitrates, Cations, Anions, Chemistry of precipitation, Arkansas.

Two streams, the North Fork and East Fork of the Saline River, in southwest Arkansas were studied from August 1984 to October 1985 to assess their response to acidic deposition. The wet deposition had a volume weighted annual average pH of 4.65. Sulfate accounted for > 50% of the major anions whereas calcium and sodium accounted for > 70% of the base cations. Sulfate deposition (wet deposition) was calculated to be about 26 kg/ha/yr. During the wet months, both cations and anions had higher concentrations with higher pH and higher ANC values than during the dry months. In general, chloride, sulfate and the base cations varied inversely with rainfall. The East and North Fork stream chemistry was characterized by pH ranges from about 5.9 to 7.0, low nutrient concentrations, and variable sulfate and nitrate concentrations. Median ANC values for the East and North Forks during the study were 99 and 17 microequivalents/L, respectively. Generally, minimal changes in stream chemistry occurred during the summer and fall rainfall events with maximum changes occurring during winter rainfall events. ANC and pH followed this trend except for a maximum change in ANC of 142 microequivalents/L during the September event in the East Fork. Base cations remained fairly constant or decreased sightly with declining calcium concentrations being the most noticeable cause of cation decreases. Seasonal and annual mass budgets were computed for hydrogen, nitrate, sulfate, major anions plus ANC, and sum of base cations. Inputs were calculated from bulk deposition and, therefore, include a component of dry deposition. Annually, both watersheds retained > 90% of the hydrogen and nitrate inputs and exported or lost about twice the base cations received through precipitation inputs. The sum of the major anions plus ANC showed similar inputs and outputs with ANC export primarily compensating for nitrate retention. Sulfates were near steady state. There were seasonal differences with a net export of sulfate, cations and anions plus ANC during the wet periods and a net retention of these constituents during the dry periods. (Lantz-PTT)
W89-08517

SPECIAL FLOOD HAZARD EVALUATION REPORT: MAUMEE RIVER, HENRY COUNTY, OHIO.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 4A.
W89-08535

QUANTIFICATION OF FLOODPLAIN INUNDATION BY THE USE OF LANDSAT AND METRIC CAMERA INFORMATION, BELIZE, CENTRAL AMERICA,
Aston Univ., Birmingham (England).
For primary bibliographic entry see Field 7C.
W89-08594

STUDY WITH NOAA-7 AVHRR-IMAGERY IN MONITORING EPHEMERAL STREAMS IN THE LOWER CATCHMENT AREA OF THE TANA RIVER, KENYA,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 7A.
W89-08603

APPLICATION OF PHYSIOGRAPHIC PHOTO INTERPRETATION TECHNIQUE TO ANALYSE THE ENIGMATIC DRAINAGE PROBLEM OF THE HYDERABAD METROPOLITAN REGION, PAKISTAN,
Soil Survey of Pakistan, Lahore.
For primary bibliographic entry see Field 7C.
W89-08605

ESTIMATES OF STREAMFLOW CHARACTERISTICS FOR SELECTED SMALL STREAMS, BAKER RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. R. Williams.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4006, 1987. 28p, 4 fig, 12 tab, 5 ref.

Descriptors: *Streamflow forecasting, *Flow characteristics, *Streamflow, *Mathematical studies, *Washington, Regression analysis, Mathematical equations, Flow profiles, Precipitation, Statistical analysis, Statistical methods, Correlation analysis, Baker River, River basin.

Regression equations were used to estimate streamflow characteristics at eight ungaged sites on small streams in the Baker River basin in the North Cascade Mountains, Washington, that could be suitable for run-of-the-river hydropower development. The regression equations were obtained by relating known streamflow characteristics at 25 gaging stations in nearby basins to several physical and climatic variables that could be easily measured in gaged or ungaged basins. The known streamflow characteristics were mean annual flows, 1-, 3-, and 7-day low flows and high flows, mean monthly flows, and flow duration. Drainage area and mean annual precipitation were not the most significant variables in all the regression equations. Variance in the low flows and the summer mean monthly flows was reduced by including an index of glacierized area within the basin as a third variable. Standard errors of estimate of the regression equations ranged from 25 to 88%, and the largest errors were associated with the low flow characteristics. Discharge measurements made at the eight sites near midmonth each month during 1981 were used to estimate monthly mean flows at the sites for that period. These measurements also were correlated with concurrent daily mean flows from eight operating gaging stations. The correlations provided estimates of mean monthly flows that compared reasonably well with those estimated by the regression analyses. (Author's abstract)
W89-08624

FLOODS IN KANSAS AND TECHNIQUES FOR ESTIMATING THEIR MAGNITUDE AND FREQUENCY ON UNREGULATED STREAMS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. W. Clement.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4008, 1987. 50p, 8 fig, 5 tab, 34 ref.

Descriptors: *Flood forecasting, *Flood peak, *Floods, *Kansas, *Flood frequency, *Statistical analysis, Flood discharge, Statistical models, Least squares method, Streamflow, Flow profiles, Hydrologic data condition.

Techniques are presented for generalizing the skewness coefficient of log-Pearson Type III distributions of annual maximum discharges and for flood magnitudes that have selected recurrence intervals from 2 to 100 yr. A weighted least-square (WLS) regression model was used to generalize the coefficients of station skewness that resulted in a root-mean-sq error of prediction of 0.35 compared to 0.55 for the skewness map published in Bulletin 17B of the U.S. Water Resources Council. Estimates of generalized skewness were computed for each of 245 streamflow gaging stations with a minimum of 10 years of record and a contributing drainage area of < 20,000 sq mi. The WLS regression model also was used to develop equations for estimating flood magnitude for selected recurrence intervals for ungaged stream locations by using data from 218 of the 245 streamflow gaging stations that had contributing-drainage areas of less than 10,000 sq mi. The errors of prediction of the most reliable WLS equations ranged from 28 to 42%. The WLS equations were compared statistically to previous developed equations and were determined to be different and more accurate than previously published equations. Flood magnitudes and frequencies for 245 streamflow gaging stations, based on data collected through the 1983 water

year, are presented along with a summary of the seasonal distribution of annual maximum discharges and an analysis of the maximum observed discharges. (Author's abstract)
W89-08625

RELATION BETWEEN GROUND-WATER AND SURFACE WATER IN THE HILLSBOROUGH RIVER BASIN, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-08627

TRAVELTIME AND DISPERSION IN THE NEW RIVER, HINTON TO GAULEY BRIDGE, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08628

HYDRAULIC AND CHANNEL CHARACTERISTICS OF SELECTED STREAMS IN THE KANTISHNA HILLS AREA, DENALI NATIONAL PARK AND PRESERVE, ALASKA, 1982-84,
Geological Survey, Anchorage, AK. Water Resources Div.
J. L. Van Maanen, and G. L. Solin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-325, 1986. 105p, 102 fig, 3 ref.

Descriptors: *Hydraulic properties, *Alaska, *Placer mining, *Streamflow, *Channel morphology, *National parks, *Environmental effects, Arkansas, Channel morphology, Streambeds, Particle size, Mining, Gold.

The Kantishna Hills area of the Denali National Park and Preserve contains extensive placer gold deposits. In order to develop plans for the management of this natural resource, and to assess the effects of placer mining on aquatic systems, documentation of the physical characteristics of the streams in the area is needed. Channel morphology, streamflow and streambed composition data were collected at 14 stream reaches in the Kantishna Hills area in September 1982 and in June, July, August, and September of 1983 and 1984. The reaches selected include locations of historical and current mining activity and locations which are undisturbed. The data indicate only minor differences in the physical properties of the streams in mined and unmined drainage basins. The composition of streambeds below mined areas tended to consist of finer sized particles and exhibited less variation in mean particle size than streambed in unmined basins. This may be due in part to the natural sorting of material in stream channels because mined areas, and thus study reaches below them, tended to be located relatively farther downstream (nearer the stream mouth) than were study reaches in basins where no mining has occurred. Changes in the physical properties of the streams which could be directly attributed to mining activity were noted at only one location, Rainy Creek near Kantishna, where the stream had been diverted from its natural channel by the construction of settling ponds. (Author's abstract)
W89-08638

TECHNIQUES FOR ESTIMATING FLOOD-FLOW FREQUENCY FOR UNREGULATED STREAMS IN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
S. D. Waltemeyer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4104, 1986. 56p, 3 fig, 15 tab, 23 ref.

Descriptors: *Flood frequency, *Flood flow, *Streamflow, *Statistical analysis, *New Mexico, Flow discharge, Statistical methods, Mathematical studies, Flood discharge.

Equations for estimating flood discharges for exceedance probabilities of 0.50, 0.20, 0.10, 0.04, 0.02, and 0.01 at ungaged sites in New Mexico were developed and updated from streamflow gaging station data through 1982. The 1984 data from selected stations in the southwestern part of the State were also used because of the high discharges that occurred. The State was divided into eight physiographic regions and equations were developed for each region. The logarithms of annual flood peaks for the respective exceedance probabilities were related to logarithms of basin and climatic characteristics. The average standard error of estimate of a flood peak for an exceedance probability of 0.01 ranged from 44% to 81%, a significant improvement over previous studies. New techniques for weighting independent estimates of flood discharges at gaging stations by each estimate's variance are presented. The variances are the squares of the standard errors. Standard errors of the estimated flood discharges for the exceedance probabilities are presented for all streamflow gaging stations. Flood frequency characteristics at 219 gaging stations are also included. (Author's abstract)
W89-08647

APPLICATION OF THE PRECIPITATION-RUNOFF MODELING SYSTEM TO SMALL BASINS IN THE PARACHUTE CREEK BASIN, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
J. M. Norris.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4115, 1986. 38p, 19 fig, 14 tab, 8 ref.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Rainfall-runoff relationships, *Model studies, Colorado, Streamflow, Runoff, Hydrologic regime, Hydrologic models, Climate.

The U.S. Geological Survey's Precipitation-Runoff Modeling System was calibrated and verified for two small basins in western Colorado. Average monthly mean, average monthly maximum, average annual total, and average daily mean observed and model predicted streamflow differences were small, on the average < 10%, indicating the Precipitation-Runoff Modeling System can, when adequately calibrated, satisfactorily estimate these streamflow factors. Average monthly minimum streamflow generally was over-predicted, but actual differences between observed and model predicted average monthly minimum streamflow are small. To determine relative errors of streamflow prediction in ungaged basins, three different model parameter sets were used to predict streamflow in a nearby gaged basin. The first set of parameters was based on the assumption that little information about this basin was available. Model parameters used to calibrate basins approximately 75 mi away were adjusted to model this basin on the basis of easily obtainable physical basin characteristics, such as elevation and slope. The second set of parameters was based on the first set, except it was assumed that local climate information was available to estimate the model's climatic parameters for the basin better. The second set of parameters improved streamflow estimation in this basin by about 7% over the first model parameter set. The third set of model parameters assumed that the model had been calibrated to similar, nearby basins. This model parameter set was derived from the model parameters of the earlier calibrated basins. Using these calibrated model parameter values improved streamflow estimates by approximately 21% over the second parameter set. The average difference between observed and predicted average annual streamflow for the basin using these parameters was 16.3%. For comparison, the average difference between observed and predicted average annual total streamflow for the calibration basins was 12.9%. This suggests that, with some increase in error, this model can be used to estimate streamflow in ungaged basins, if the model has been calibrated to a nearby gaged basin with similar physical characteristics. (Lantz-PTT)
W89-08652

GEOHYDROLOGY AND MODEL ANALYSIS OF STREAM-AQUIFER SYSTEM ALONG THE ARKANSAS RIVER IN KEARNY AND FINNEY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Dunlap, R. J. Lindgren, and C. G. Sauer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-222, 1983. 84p, 38 fig, 3 tab, 23 ref.

Descriptors: *Surface-groundwater relations, *Geohydrology, *Hydrologic models, *Aquifers, *Arkansas River, *Kansas, Simulation analysis, Model studies, Groundwater recharge, Irrigation, Groundwater depletion, Seepage loss, Hydraulic conductivity, Water table, Groundwater level.

A study was made to determine geohydrologic conditions in an area comprising nearly 850,000 acres along the Arkansas River valley in Kearny and Finney Counties, southwestern Kansas. The Arkansas River meanders atop and interacts hydraulically with the area's multilayered, unconsolidated aquifer system. Declines in static water levels in wells in the heavily pumped lower aquifer ranged from 20 to 80 ft during 1974-80. Simulated 1974-80 conditions depicted an average annual recharge to the unconsolidated aquifer system of 66,900 acre-ft from precipitation and 36,200 acre-ft from river and canal seepage and boundary inflow. Simulated average annual discharge consisted of 634,800 acre-ft from pumpage and boundary outflow. Simulated average annual recharge to the unconsolidated aquifer system was 531,700 acre-ft less than the average annual discharge, indicating the groundwater resource is currently (1982) being mined in the study area. Simulation also indicated that there would be sufficient saturated thickness in 2005 for irrigation if 1980 hydrologic conditions continued. Seepage losses from the Arkansas River and irrigation canals are a major source of recharge to the unconsolidated aquifer system. Streamflow seepage losses could be decreased by: (1) decreasing the number of wells pumping in the study area in order to reduce downward leakage from the valley aquifer, or (2) increasing streamflow discharge in order to recharge the valley aquifer. The rate and direction of flow between the river and the valley aquifer depend on the hydraulic conductivity of the streambed and the hydraulic gradient between the river stage and the water table. As long as river stage remains high, the water table in the valley aquifer continues to rise. However, a rise in the water table in the valley aquifer because of recharge from the river will correspond to increased downward leakage to the lower aquifer, impeding recharge to the valley aquifer. (Lantz-PTT)
W89-08658

FLOODS OF APRIL 1983 IN SOUTHERN MISSISSIPPI AND SOUTHEASTERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, and G. D. Firda.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-685, 1983. 32p, 6 fig, 2 tab, 2 plates, 5 ref.

Descriptors: *Flood peak, *Mississippi, *Louisiana, *Floods, Flood frequency, Flood crest, Flood discharge, Costs, Flood damage.

Extreme flooding occurred in April 1983 in southern Mississippi and southeastern Louisiana. The floods resulted from a near-stationary cold front, which moved slowly across Louisiana and Mississippi. Flood heights and discharges of many streams exceeded previously known maximums of record, and for many the recurrence interval of peak discharge exceeded 100 years. On Black Creek, near Brooklyn, Miss., the previous maximum stage (since 1961) was exceeded by 4.26 ft, and the April 7 peak discharge of 42,500 cu ft/sec was about two times the previous maximum discharge. This flood exceeded the 100-yr event. In southeastern Louisiana, the area with the most severe flooding was in the Bogue Chitto basin. At

the Franklinton, LA, Station, the April 7 peak discharge of 125,000 cu ft/sec was more than two times the previous maximum discharge. In April 1900 the stage at this site was 29.6 ft, 4.9 ft higher than the April 1981 peak. An extreme event also occurred on the Tchefuncta River near Franklinton, LA. The previous maximum stage (since 1949) was exceeded by 3.75 ft, and the April 6 discharge of 26,900 cu ft/sec is more than three times the previous maximum. This discharge also exceeded the 100-yr event. Combined flood damages for both States totaled in the hundred of millions of dollars. (Lantz-PTT)
W89-08666

COST EFFECTIVENESS OF STREAM-GAGING PROGRAM IN MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08672

FLOOD-DEPTH FREQUENCY RELATIONS FOR STREAMS IN ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
D. A. Olin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4296, 1986. 46p, 17 fig, 2 tab, 8 ref.

Descriptors: *Flood peak, *Flood frequency, *Streams, *Alabama, Mathematical equations, Regression analysis, Mathematical studies, Drainage systems, Floods, Flood routing.

Equations were defined for estimating the depth of water for floods having recurrence intervals of 2, 5, 10, 25, 50, 100, and 200 years on rural and urban streams in Alabama. Multiple regression analyses were made using the 'maximum RSQUARE improvement' procedures. The dependent variable was the flood depth and the independent variables were 10 basin and climatic characteristics. For rural streams, drainage area size (0.44 to 1,344 sq mi) was the only statistically significant independent variable tested to estimate flood depths in six different hydrologic areas. Other variables affecting flood depth relations are reflected in the equation constant and coefficient for each hydrologic area. These account for differences in geologic and topographic characteristics. For urban streams, drainage area size (0.16 to 83.5 sq mi) and percent impervious area (8.3% to 42.9%) of the basin were the most significant independent variables tested to estimate flood depths. For most streams where the drainage area is > 1,344 sq mi, the drainage basin extends into more than one hydrologic area and the equations presented would not apply. Flood profile data and gaging station records are available from the U.S. Geological Survey for use in estimating flood depths for these large streams. Flood routing and historic flood profiles are also available for many of the large streams which have flood regulation. (Author's abstract)
W89-08675

MANUAL FOR ESTIMATING SELECTED STREAMFLOW CHARACTERISTICS OF NATURAL-FLOW STREAMS IN THE COLORADO RIVER BASIN IN UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
R. C. Christensen, E. B. Johnson, and G. G. Plantz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4297, 1986. 39p, 6 tab, 1 plate, 17 ref.

Descriptors: *Streamflow, *Flow profiles, *Colorado River, *Utah, Stream discharge, Regression analysis, Mathematical equations, Precipitation.

Methods are presented for estimating 10 streamflow characteristics at three types of sites on natural flow streams in the Colorado River Basin in Utah. The streamflow characteristics include average discharge and annual maximum 1-, 7-, and 15-day mean discharges for recurrence intervals of 10, 50 and 100 years. At or near gaged sites, two methods weight gaging station data with regression equation values to estimate streamflow characteristics. At sites on ungaged streams, a method estimates streamflow characteristics using regression equations. The regression equations relate the streamflow characteristics to the following basin and climatic characteristics: contributing drainage area, mean basin elevation, mean annual precipitation, main channel slope, and forested area. Separate regression equations were developed for four hydrologically distinct regions in the study area. The standard error of estimate for the 10 streamflow characteristics ranges from 13% to 87%. Basin, climatic, and streamflow characteristics, available as of September 30, 1981, are presented for 135 gaging stations in Utah, Arizona, Colorado, and Wyoming. In addition, weighted estimates of the streamflow characteristics based on station data and the regression equation estimates are provided for most gaging stations. (Author's abstract)
W89-08676

SURFACE-WATER HYDROLOGY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
W. M. Kappel, and W. E. Harding.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4309, 1987. 36p, 6 fig, 4 tab, 8 ref, 4 append.

Descriptors: *Surface-groundwater relations, *Hydrologic systems, New York, Precipitation, Rainfall-runoff relationships, Hydrologic budget, Soil water, Groundwater movement, Radioactive wastes, Underground waste disposal, Storm runoff, Evapotranspiration.

Precipitation data were collected from October 1980 through September 1983 from three recording gages at the Western New York Nuclear Service Center, and surface water data were collected at three continuous-record gaging stations and one partial-record gage on streams that drain a 0.7 sq km part of the site. Seepage from springs was measured periodically during the study. The data were used to identify runoff characteristics at the waste burial ground and the reprocessing plant area, 400 meters to the north. Preliminary water budgets for April 1982 through March 1983 were calculated to aid in the development of groundwater flow models to the two areas. Nearly 80% of the measured runoff from the burial ground area was storm runoff; the remaining 20% was base flow. In contrast, only 30% of the runoff leaving the reprocessing plant area was storm runoff, and 70% was base flow. This difference is attributed to soil composition. The burial ground soil consists of clayey silty till that limits infiltration and causes most precipitation to flow to local channels as direct runoff. In contrast, the reprocessing plant area is overlain by alluvial sand and gravel that allows rapid infiltration of precipitation and subsequent steady discharge from the water table to nearby stream channels and seepage faces. Measured total annual runoff and estimated evapotranspiration from the reprocessing plant area exceeded the precipitation by 35%, which suggests that the groundwater basin is larger than the surface water basin. The additional outflow probably includes underflow from bedrock upgradient from the plant, water leakage from plant facilities, and groundwater flow from adjacent basins. (Author's abstract)
W89-08678

QUALITY OF WATER AND BED MATERIAL IN STREAMS OF LOGAN TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY, 1984,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08679

DETERMINATION OF REAERATION-RATE COEFFICIENTS OF THE WABASH RIVER, INDIANA, BY THE MODIFIED TRACER TECHNIQUE,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08687

DISCHARGE RATINGS FOR CONTROL GATES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 8B.
W89-08720

WATER RESOURCES OF THE LOWER RIO GRANDE DE ARECIBO ALLUVIAL VALLEY, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
V. Quinones-Aponte.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4160, 1986. 38p, 30 fig, 9 tab, 30 ref.

Descriptors: *Alluvial aquifers, *Groundwater resources, *Water resources data, *Alluvial rivers, *Rio Grande de Arecibo, *Hydrologic budget, *Puerto Rico, Surface water, Groundwater budget, Stream discharge, Streamflow, Groundwater recharge, Surface-groundwater relations, Aquifers, Geohydrology, Well yield, Transmissivity, Groundwater movement, Groundwater depletion, River basin development.

An assessment of the surface and groundwater resources of the lower Rio Grande de Arecibo alluvial valley was made between 1981 and 1983. Rio Grande de Arecibo is the major source of water in the valley with a mean-annual discharge of 527 cu ft/sec (382,000 acre-ft/yr). Its lowest mean-daily flow (low flow) during 12 yr of record is 50 cu ft/sec. Withdrawals of water from Rio Grande de Arecibo exceeding 15 cu ft/sec during periods of extreme low flows could cause reduction of recharge to the aquifer. However, withdrawals of as much as 35 cu ft/sec are possible when base flow ranges from 90 to 200 cu ft/sec without causing a reduction of aquifer recharge. An unconfined aquifer within the alluvial valley is hydraulically continuous with bordering limestone formations. A clay layer divides the alluvial aquifer into two separate hydraulic systems. Groundwater from the alluvial aquifer above the clay layer has not been widely developed. However, high yielding wells presently yield as much as 9.6 mil gal/day (10,800 acre-ft/yr) from the aquifers occurring below the clay layer within the alluvium and underlaying limestones. Transmissivity ranges from 3,000 sq ft/day in the alluvial area to 42,000 sq ft/day in the adjacent limestone areas. Total groundwater flow through aquifers within the study area (excluding water withdrawn by wells) is about 20.6 mil gal/day (23,100 acre-ft/yr). 50% of this amount is estimated to flow to the eastern area of Cano Tiburones and discharges as springs and seeps. An estimated 9.4 mil gal/day (10,500 acre-ft/yr) of additional groundwater can be withdrawn from the aquifers below the clay layer without reversing the northward hydraulic gradient. Seepage from Rio Grande de Arecibo to the groundwater system at the east side of the valley is probably the key to the development of groundwater resources in the Arecibo area. San Pedro spring, with an average discharge of 8.6 mil gal/day (9,600 acre-ft/yr), is undeveloped and represents a potential alternate source of water. (Author's abstract)
W89-08740

HYDROLOGIC EFFECTS OF GROUND- AND SURFACE-WATER WITHDRAWALS IN THE MILFORD AREA, ELKHART AND KOSCIUSKO COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
H. A. Lindgren, J. G. Peters, D. A. Cohen, and E. J. Crompton.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4166, 1985. 76p, 42 fig, 11 tab, 21 ref.

Descriptors: *Irrigation effects, *Selective withdrawal, *Groundwater depletion, *Surface water, *Hydrologic models, *Indiana, Groundwater irrigation, Irrigation water, Agricultural water, Simulation analysis, Groundwater recharge, Model studies, Drawdown, Streamflow depletion.

Agricultural irrigation in northern Indiana has increased rapidly since 1975 and might double by the year 2000. In 1982, an average of 2 in. of water was used to irrigate 975 acres of sandy soil in north-central Indiana overlying highly transmissive outwash deposits. Irrigational pumpage was 75% of the summer water use but was less than potential irrigational pumpage because: (1) only one-third of the suitable land was irrigated, and (2) precipitation was near normal for the year. A three-dimensional digital flow model, calibrated with data collected in 1982, was used to simulate four hypothetical pumping plans representing various irrigational schemes and possible rainfall conditions: (1) 1982 acreage irrigated and 1982 (above normal) precipitation; (2) 1982 acreage irrigated and below-normal precipitation; (3) maximum acreage irrigated and normal precipitation; and (4) maximum acreage irrigated and below-normal precipitation. A fifth pumping plan was used to simulate maximum year-round water use. Of the four pumping plans that simulated irrigational pumpage, plan 4 had the greatest effect on ground- and surface-water supply. The model predicted a potentiometric decline of as much as 20.7 ft over an 8-acre area of the aquifer. Streamflow in Turkey Creek would be reduced 39% by simulated groundwater and surface water pumpage but remaining flow would still be twice the 7-day, 10-yr low flow. The rate of pumping used in plan 5 was nearly 4 times the pumping rate in 1982. Potentiometric decline for plan 5 was as much as 40% of available drawdown, and predicted streamflow reduction would cause flow in Turkey Creek to decrease below the 7-day, 10-yr low flow. Results of plans 1, 2, 3, and 4 indicate that the outwash system provides adequate water for current (1982) needs and substantial growth for irrigation. Plan 5 indicates that water use could increase substantially before effects of pumping would prevail year-round. (Lantz-PTT)
W89-08745

MAJOR AND TRACE-ELEMENT ANALYSES OF ACID MINE WATERS IN THE LEVIATHAN MINE DRAINAGE BASIN, CALIFORNIA/NEVADA--OCTOBER, 1981 TO OCTOBER, 1982,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08748

EFFECTS OF WETLANDS ON QUALITY OF RUNOFF ENTERING LAKES IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08749

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAMS IN NEW HAMPSHIRE AND VERMONT,
Geological Survey, Augusta, ME. Water Resources Div.
J. A. Smath, and F. E. Blackey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4173, 1986. 134p, 13 fig, 19 tab, 17 ref.

Descriptors: *Cost-benefit analysis, *Stream gages, *Data acquisition, *New Hampshire, *Vermont, Streamflow, Costs, Hydrologic data, Budgeting, Economic aspects, Monitoring, Error analysis.

Data uses and funding sources were identified for the 73 continuous stream gages currently (1984) being operated. Eight stream gages were identified as having insufficient reason to continue their operation. Parts of New Hampshire and Vermont were identified as needing additional hydrologic data. New gages should be established in these regions as funds become available. Alternative methods for providing hydrologic data at the stream gaging stations currently being operated were found to lack the accuracy that is required for their intended use. The current policy for operation of the stream gages requires a net budget of $297,000/yr. The average standard error of estimation of the streamflow records is 17.9%. This overall level of accuracy could be maintained with a budget of $285,000 if resources were redistributed among gages. Cost-effective analysis indicates that with the present budget, the average standard error could be reduced to 16.6%. A minimum budget of $278,000 is required to operate the present stream gaging program. Below this level, the gages and recorders would not receive the proper service and maintenance. At the minimum budget, the average standard error would be 20.4%. The loss of correlative data is a significant component of the error in streamflow records, especially at lower budgetary levels. (Author's abstract)
W89-08751

ESTIMATION OF FLOOD PEAKS FROM CHANNEL CHARACTERISTICS IN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
D. K. Roth.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4175, 1985. 63p, 10 fig, 11 tab, 7 ref.

Descriptors: *Flood peak, *Flood forecasting, *Channel morphology, *Ohio, Hydraulic properties, Channel flow, Alluvial channels, Mathematical equations, Statistical analysis, Streamflow, Regression analysis.

Regression equations were developed to estimate flood peaks with selected recurrence intervals of 2 to 100 yr for Ohio streams with alluvial and bedrock channels. Channel geometry characteristics, rather than basin characteristics, were used as independent variables. Width of active channel was the only channel geometry characteristic significant at the 5% level in the estimating equations for alluvial channels. Standard errors of estimate for those equations range from 42% for the 2-yr flood peak to 55% for the 100-yr flood peak. The equations were developed from data collected at 142 gaging stations that have active channel widths ranging from 2 to 495 ft. For streams with bedrock or firm channels, depth of the bankfull channel and active channel width were statistically significant characteristics at the 5% level for all but the 2-yr recurrence interval flood-peak equation, for which only active channel width was statistically significant. Standard errors of estimate range from 33% for the 5-yr flood peak to 40% for the 100-yr flood peak when both significant variables are included in the equations. Standard errors of estimate range from 36% to 46% when only the active channel width independent variable is used. These equations are based on channel geometry data collected at 20 gaging stations that have active channel widths ranging from 14 to 240 ft and average bankfull channel depths ranging from 2.5 to 9.2 ft. Channel geometry characteristics also were measured at 168 ungaged sites to provide information that can be used to better define the geographic area boundaries in three areas of Ohio where the boundaries were previously defined in a flood magnitude and frequency report. (Author's abstract)
W89-08752

COMPUTER PROGRAM FOR ANALYZING CHANNEL GEOMETRY,
Geological Survey, Reston, VA. Water Resources Div.
R. S. Regan, and R. W. Schaffranek.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4335, 1985. 49p, 16 fig, 1 tab, 10 ref, 3 append.

Descriptors: *Computer programs, *Channel flow, *Computer models, *Hydraulic geometry, *Channel morphology, Flow profiles, Hydraulic profiles.

The Channel Geometry Analysis Program (CGAP) provides the capability to process, analyze, and format cross-sectional data for input to flow/transport simulation models or other computational programs. CGAP allows for a variety of cross-sectional data input formats through use of variable format specification. The program accepts data from various computer media and provides for modification of machine-stored parameter values. CGAP has been devised to provide a rapid and efficient means of computing and analyzing the physical properties of an open-channel reach defined by a sequence of cross sections. CGAP's 16 options provide a wide range of methods by which to analyze and depict a channel reach and its individual cross-sectional properties. The primary function of the program is to compute the area, width, wetted perimeter, and hydraulic radius of cross sections at successive increments of water surface elevation (stage) from data that consist of coordinate pairs of cross-channel distances and land surface or channel bottom elevations. Longitudinal rates-of-change of cross-sectional properties are also computed, as are the mean properties of a channel reach. Output products include tabular lists of cross-sectional area, channel width, wetted perimeter, hydraulic radius, average depth, and cross-sectional symmetry computed as functions of stage; plots of cross sections; plots of cross-sectional area and (or) channel width as functions of stage; tabular lists of cross-sectional area and channel width computed as functions of stage for subdivisions of a cross section; plots of cross sections in isometric projection; and plots of cross-sectional area at a fixed stage as a function of longitudinal distance along an open-channel reach. A Command Procedure Language program and Job Control Language procedure exist to facilitate program execution on the U.S. Geological Survey Prime and Amdahl computer systems respectively. (Lantz-PTT)
W89-08756

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08760

COST-EFFECTIVENESS OF THE FEDERAL STREAM-GAGING PROGRAM IN VIRGINIA,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08761

SUSPENDED SEDIMENT IN SELECTED STREAMS OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-08765

TRANSIT LOSSES AND TRAVELTIMES FOR RESERVOIR RELEASES DURING DROUGHT CONDITIONS ALONG THE NEOSHO RIVER FROM COUNCIL GROVE LAKE TO IOLA, EAST-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, and R. J. Hart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4003, 1985. 40p, 14 fig, 11 tab, 20 ref.

Descriptors: *Streamflow, *Transit loss, *Water loss, *Reservoir releases, *Drought, Water management, Water resources management, Channel

flow, Water management, Hydraulic models, Reservoirs, Council Grove Lake, Kansas.

Knowledge of the transit losses and water-wave traveltimes in the Neosho River for varying reservoir-release volumes and durations is necessary for proper management of water supply. Two reaches were studied along the Neosho River in east-central Kansas. The upper reach is from Council Grove Lake to John Redmond Reservoir, a distance of 83.0 river miles. The lower reach is from John Redmond Reservoir to Iola, Kansas, a distance of 56.3 river miles. Channel and aquifer characteristics were estimated from available data and used in a streamflow routing model. These estimated characteristics were verified using the model by comparing simulated reservoir releases to observed reservoir releases. The verified model then was used to simulate transit losses (or gains) and traveltimes for selected reservoir release volumes and durations from Council Grove Lake to Iola. Transit losses and traveltimes were investigated for the selected reservoir releases while under a severe drought antecedent streamflow condition (zero base flow) and a less severe drought antecedent streamflow condition (2% drought base flows). The largest total transit loss from Council Grove Lake to Iola occurred during the severe drought antecedent streamflow condition, small reservoir release rates, and long reservoir release durations. The total transit loss included water that was temporarily lost to bank storage. For a severe drought condition, transit losses ranged from 1,100 acre-ft for a release volume of 1,840 acre-ft for a duration of 50 days to 6,280 acre-ft for a release volume of 6,280 acre-ft for a duration of 365 days. For a less severe drought condition, transit losses ranged from 860 acre-ft to 3,234 acre-ft for the same release volumes and durations as for the severe drought condition. (Author's abstract)
W89-08768

HYDROLOGIC MONITORING OF SELECTED STREAMS IN COAL FIELDS OF CENTRAL AND SOUTHERN UTAH-SUMMARY OF DATA COLLECTED, AUGUST 1978-SEPTEMBER 1984,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08772

POTENTIAL EFFECTS OF ANTICIPATED COAL MINING ON SALINITY OF THE PRICE, SAN RAFAEL, AND GREEN RIVERS, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08774

METHODS FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN MONTANA BASED ON DATA THROUGH 1983,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4027, May 1986. 85p, 22 fig, 5 tab, 16 ref.

Descriptors: *Floods, *Montana, *Flood frequency, *Data interpretation, *Flood peak, Mathematical equations, Regression analysis, Flow profiles, Mathematical studies, Hydrologic data.

Equations are presented for estimating flood magnitudes for ungaged sites in Montana based on data through 1983. The State was divided into eight regions based on hydrologic conditions, and separate multiple regression equations were developed for each region. These equations relate annual flood magnitudes and frequencies to basin characteristics and are applicable only to natural flow streams. In three of the regions, equations also were developed relating flood magnitudes and frequencies to basin characteristics and channel geometry measurements. The standard errors of estimate for an exceedance probability of 1% ranged from 39% to 87%. Techniques are described for estimating annual flood magnitude and flood frequency information at ungaged sites based on data from gaged sites on the same stream. Included are curves relating flood frequency information to drainage area for eight major streams in the State. Maximum known flood magnitudes in Montana are compared with estimated 1%-chance flood magnitudes and with maximum known floods in the United States. Values of flood magnitudes for selected exceedance probabilities and values of significant basin characteristics and channel geometry measurements for all gaging stations used in the analysis are tabulated. Included are 375 stations in Montana and 28 nearby stations in Canada and adjoining States. (Author's abstract)
W89-08778

CLUSTER ANALYSIS OF PHYTOPLANKTON DATA COLLECTED FROM THE NATIONAL STREAM QUALITY ACCOUNTING NETWORK IN THE TENNESSEE RIVER BASIN, 1974-81,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08780

COMPARISON OF FLOOD FREQUENCY ESTIMATES FROM SYNTHETIC AND OBSERVED DATA ON SMALL DRAINAGE AREAS IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Colson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4034, 1986. 23p, 9 fig, 2 tab, 11 ref.

Descriptors: *Flood frequency, *Mississippi, *Hydrologic models, *Flood forecasting, *Small watersheds, Comparison studies, Rainfall-runoff relationships, Flood peak, Graphical analysis, Statistical analysis, Data collections, Stream gages.

In 1964 the U.S. Geological Survey in Mississippi expanded the small stream gaging network for collection of rainfall and runoff data to 92 stations. To expedite availability of flood frequency information a rainfall-runoff model using available long-term rainfall data was calibrated to synthesize flood peaks. Results obtained from observed annual peak flow data for 51 sites having 16 yr to 30 yr of annual peaks are compared with the synthetic results. Graphical comparison of the 2, 5, 10, 25, 50, and 100-year flood discharges indicate good agreement. The root mean square error ranges from 27% to 38% and the synthetic record bias from -9% to -18% in comparison with the observed record. The reduced variance in the synthetic results is attributed to use of only four long-term rainfall records and model limitations. The root mean square error and bias is within the accuracy considered to be satisfactory. (Author's abstract)
W89-08784

WATER RESOURCES OF MINER COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08785

REGIONALIZATION OF LOW-FLOW CHARACTERISTICS OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
R. H. Bingham.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4191, 1986. 63p, 17 fig, 2 plates, 17 ref, 4 append.

Descriptors: *Low flow, *Tennessee, *Streamflow, *Surface-groundwater relations, Mathematical studies, Flow properties, Mathematical equations, Geohydrology, Stream beds, Aquifers, Transmissivity, Estimating, Drainage basins.

Procedures for estimating 3-day 2-year, 3-day 10-year, 3-day 20-year, and 7-day 10-year low flows at ungaged stream sites in Tennessee are based on surface geology and drainage area size. One set of equations applies to west Tennessee streams, and another set applies to central and east Tennessee streams. The equations do not apply to streams where flow is significantly altered by activities of man. Standard errors of estimate of equations for west Tennessee are 24 to 32% and for central and east Tennessee 31 to 35%. Streamflow recession indexes, in days/log cycle, are used to account for effects of geology of the drainage basin on low flow of streams. The indexes in Tennessee range from 32 days/log cycle for clay and shale to 350 days/log cycle for gravel and sand, indicating different aquifer characteristics of the geologic units that sustain streamflows during periods of no surface runoff. Streamflo.. recession rate depends primarily on transmissivity and storage characteristics of the aquifers, and the average distance from stream channels to basin divides. Geology and drainage basin size are the most significant variables affecting low flow in Tennessee streams according to regression analyses. (Author's abstract)
W89-08813

FLOOD OF DECEMBER 1982 AND THE 100- AND 500-YEAR FLOOD ON THE BUFFALO RIVER, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 4A.
W89-08814

FLOOD OF OCTOBER 1983 IN SOUTHEASTERN ARIZONA-AREAS OF INUNDATION IN SELECTED REACHES ALONG THE GILA RIVER,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08815

ESTIMATION OF RECHARGE OF SAND AQUIFER OF THE ISLAND OF MANNAR, SRI LANKA,
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-08857

FLOOD HYDROLOGY: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON FLOOD FREQUENCY AND RISK ANALYSES, 14-17 MAY 1986, LOUISIANA STATE UNIVERSITY, BATON ROUGE, U.S.A.
For primary bibliographic entry see Field 10C.
W89-08863

CURRENT STATE OF HYDROLOGIC MODELING AND ITS LIMITATIONS,
Dames and Moore, Golden, CO.
A. Prakash.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 1-16, 2 fig, 5 tab, 27 ref.

Descriptors: *Flood forecasting, *Hydrologic models, *Model studies, *Storm runoff, *Streamflow, Stochastic models, Model testing, Regression analysis, Frequency analysis, Flood frequency, Drought, Estimating equations, Forecasting, Prediction, Research priorities, Comparison studies, Performance evaluation, Precision.

A brief description of commonly used hydrologic models is presented. These include storm runoff models, deterministic models for generation of sequential streamflows, regression and stochastic models for extension of hydrologic data, and models for frequency analysis of floods and droughts and risk-based designs. The subjectivity and judgment involved in the estimation of input

parameters for each model are indicated along with the effect of the estimated values of such parameters on the output of the model. For each model, several limitations to practical applications are described. In some cases, these limitations are attributable to inadequacy of data for calibration and verification of the model, complexity of programming algorithms, and the number of input variables which have to be estimated. In others, e.g., determination of the maximum flood probability and the confidence limits of predictions for such extreme events, further research is required to develop analytical tools to yield results of desired accuracy. Areas of further research are identified to update the existing models or to develop new models to enable a practicing hydrologist to perform hydrologic analyses of water resources development projects with more certainty and better precision. (See also W89-08863) (Author's abstract)
W89-08864

MORE FREQUENT FLOODING IN LOUISIANA: CLIMATIC VARIABILITY,
Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
R. A. Muller, and J. D. McLaughlin.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 41-56, 10 fig, 10 ref.

Descriptors: *Climatology, *Correlation analysis, *Louisiana, *Climatic data, *Flood frequency, River forecasting, Discharge measurement, Precipitation, Temperature, Drainage area, Hydrologic budget, Precipitation excess, Runoff forecasting, Hydrologic data collections, Weather data collections.

Climatic events associated with the Louisiana floods of 1982-1983 are analyzed in the context of the long-term climatic regime of the region. In southeastern Louisiana there are rarely more than 40 years of river stage and discharge data available for analyses of long-term trends of flooding frequencies and intensities, and these periods of record are not long enough to evaluate the possible effects of climatic variability. Furthermore, individual cooperative station precipitation data are neither very representative of rainfall received over drainage basins, nor do they represent homogeneous data sets over extended time periods. To overcome these deficiencies, divisional climatic data are used in this study. Divisional temperature and precipitation data from 1899 to 1930 has been compiled and merged with National Climatic Data Center (NCDC) data from 1931 to date to produce a climatic data series of almost 100 years. A modified Thornthwaite water-budget model is used to estimate monthly divisional moisture surpluses, or precipitation available for groundwater recharge and runoff, for the division. Correlation analyses of flood events on regional rivers and the monthly moisture surpluses for the climatic division show only a modest relationship. Studies of the precipitation patterns of flood events, however, show that excessive rainfalls are normally limited to areas much smaller than the climatic division. Hence, flood series on small- to intermediate-sized drainage basins undoubtedly reflect the spotty or localized patterns of excessive rainfalls, and may or may not reflect regional climatic variability. The climatic divisional data are more representative of regions and probably are a better index of regional climatic variability associated with changing atmospheric circulation patterns. (See also W89-08863) (Author's abstract)
W89-08867

FLOODS OF MARCH 1982, FORT WAYNE, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. R. Glatfelter, and E. H. Chin.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 57-67, 3 fig, 1 tab, 3 ref.

Descriptors: *Indiana, *Flooding, *Snowmelt, *Excess rainfall, *River basins, Flood damage, Ohio, Illinois, Michigan.

Rapid melting of a snowpack containing up to six inches (15 centimeters) of water equivalent, which occurred with a moderate rainfall of up to three inches (eight centimeters), caused major flooding in March 1982 in northern Indiana, northwestern Ohio, northeastern Illinois, and southern Michigan. Particular attention is given to the Maumee River basin, where flooding on most large streams was the worst since the devasting flood of 1913. In Fort Wayne, Indiana, flooding of the Maumee River and its tributaries, the St. Mary's and the St. Joseph Rivers, damaged 1,500 homes and 100 businesses, forced the evacuation of 9,000 people, and caused over $50 million in damage. A major flood-fighting effort prevented additional damage. (See also W89-08863) (Author's abstract)
W89-08868

FLOOD ESTIMATION FOR AN UNGAGED FLOODPLAIN,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. S. Wei, F. C. Wang, and J. A. Amft.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 69-79, 6 fig, 1 tab, 15 ref.

Descriptors: *Flood forecasting, *River basins, *Flood plains, *Simulation analysis, Louisiana, Coastal marshes, Tidal effects, Discharge capacity, Wind, Gaging stations, Flow measurement, Stage-discharge relations, Boundary conditions, Correlation analysis.

Many rivers in southern Louisiana flow into coastal embayments and terminate in broad, low-lying marsh systems with various branching distributaries and extensive floodplains. The western Terrebonne Parish marsh study area, located in south-central Louisiana, is a riverine and tidally dominated floodplain. Flooding in the region is driven mainly by astronomical tides, river discharge, and meteorological winds. There is no long-term discharge gaging station existing in the area. Stage and flow records at nearby stations are utilized for the estimation of tidal and discharge boundary conditions to be used for computer flooding simulations. The analysis attempts to correlate the in-situ short-term field measurements with the available long-term records elsewhere. A backwater flooding event was simulated. The dynamic response of floodplains to such an event is discussed briefly. (See also W89-08863) (Author's abstract)
W89-08869

DIFFUSIVE FLOOD WAVES IN LARGE RIVERS,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, and J. J. Droux.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 81-95, 7 fig, 15 ref.

Descriptors: *Flood waves, *River forecasting, *Mathematical models, Numerical analysis, Design criteria, Flow discharge, Prediction, Flood hydrographs, Flow pattern, Convection, Diffusion, Flood frequency, Kinematic wave theory.

The diffusive flow pattern of flood waves in large rivers is investigated using the zero-inertia wave approximation. The river geometry is approximated by a simple substitute river corresponding to a wide rectangular, prismatic channel of uniformly distributed wall roughness. Although the local river geometry is overlooked, the main geometrical characteristics are retained as average values. The results obtained by such a simple approach thus may not be applied to local river zones, but only to the overall discharge characteristics. The upstream river hydrograph corresponds to a single-peaked flood wave, while the lateral inflow to the river is uniformly distributed. Both of the hydrographs are normalized to the same time to peak. The governing convection-diffusion equation for river discharge as a function of space and time is solved with an implicit numerical scheme. Typical results are graphically presented; in particular, the maximum discharge as a function of the longitudinal coordinate as well as the corresponding time to peak at arbitrary locations are investigated. Owing to the generalized approach, the diffusive pattern of flood waves in large rivers can be straightforwardly analyzed, once the basic parameters such as the characteristics of the substitute river and the upstream and lateral inflows quantified. The model presented thus enables a rapid prediction of all discharge quantities and applies particularly to preliminary design information. Therefore, it is also of interest with respect to the frequency and risk analyses of floods in rivers. The results are applied to a large flood wave in the upper Rhine valley. The comparison of the predictions with the observations indicates that the present approach is able to model the main discharge characteristics. Furthermore, it is found that the reaches considered must be long in order that the diffusive flow pattern appears. Conditions in terms of basic variables are given, for which the wave diffusion can be overlooked and the kinematic wave approximation may be substituted for the zero-inertia wave approximation. (See also W89-08863) (Author's abstract)
W89-08870

RAINFALL-RUNOFF MODEL FOR AGRICULTURAL DRAINAGE IN THE EXPERIMENTAL STATION OF THE THREE-RIVER PLAIN IN HEILONGJIANG PROVINCE,
Water Conservancy Research Inst. of Heilongjiang Province, Harbin (China).
Y. Peishu, and L. Yubang.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 97-105, 2 fig, 3 tab.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Mathematical models, *Rainfall-runoff relationships, *Drainage systems, Marsh management, Drought, Floods, China, Land reclamation.

The Three-River Plain Region has an immensely wide area, amounting to more than one hundred thousand square kilometers. It is one of the important commercial grain production in the country. The region consists of a broad marshland of low level. Although most parts of the area have been drained for cultivation for years, the drainage system in the whole region is still imperfect and the frequent occurrence of drought and flood is always threatening the region very seriously, so there are many problems to be researched in the construction of water conservancy in this region. The Xinan River model was modified, tested and applied to the computation of the rainfall runoff of the Raoli River; the single-acting hydraulic connection between capillary water and free water in the surface course in the Three Water Resource Model was modified to be a double-acting hydraulic connection. Results of hydrologic research on the rainfall runoff model in the Three-River Plain Region were applied to the field drainage in this region to solve the computation problem of drainage discharge following rainfall, so as to provide the grounds necessary for the reclamation project to be designed there. Generally, the analog model has attained a satisfactory accuracy, although the areas and flows in the experimental districts are comparatively small. (See also W89-08863) (Fish-PTT)
W89-08871

APPLICATIONS OF GEOMORPHOLOGIC THEORY TO UNGAUGED WATERSHEDS IN SINAI,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.

M. N. Allam.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 107-116, 6 fig, 10 ref.

Descriptors: *Hydrologic models, *Discharge hydrographs, *Watersheds, *Model studies, *Geomorphology, Mathematical models, Prediction, Basins, Runoff volume, Infiltration.

Recently, hydrologic models based on the geomorphologic theory for the prediction of discharge hydrographs of ungauged watersheds have been developed. The mathematical development of these models is reviewed. One of these models, which accounts for the infiltration in watersheds, is applied for Elmaghara basin in the northern part of Sinai. A geomorphoclimatic model for the prediction of surface runoff volumes is also presented and applied for the same basin. The model has a simple structure and is applicable for large scale basins. It is designed in such a way that a physically based expression for infiltration can be considered. The effects of infiltration on the surface runoff of the basin are illustrated. (See also W89-08863) (Author's abstract)
W89-08872

STATISTICAL METHODS OF DETERMINING TYPICAL WINTER AND SUMMER HYDROGRAPHS FOR UNGAUGED WATERSHEDS,
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
A. Ciepielowski.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 117-124, 1 fig, 1 tab, 9 ref, 1 append.

Descriptors: *Hydrographs, *Watersheds, *Flood hydrographs, *Model studies, Estimating equations, Hydrologic data, Physiographic provinces, Model testing, Regression analysis.

Regression equations are used for determining parameters of typical winter and summer flood hydrographs. They were calculated based on hydrologic and physiographic data from lowland and highland watersheds of medium size which are situated in the Vistula basin, applying stepwise regression method. An attempt was made to utilize the obtained equations in small watersheds which differ in their character from those used for determining the equations. The results of the experiment show the possibility of applying these estimating equations in small ungauged watersheds, allowing for a possibility of an error of an order of several percent. The problem dealt with should interest hydrologists who possess basic hydrologic-historical data: water stages and flows, and who have no opportunities of obtaining more accurate data from experimental watersheds. (See also W89-08863) (Author's abstract)
W89-08873

ASPECTS OF FLOOD LEVEL COMPUTATIONS,
Waterloopkundig Lab. te Delft (Netherlands).
H. J. M. Ogink, J. G. Grijsen, and J. H. A. Wijbenga.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 125-141, 15 fig, 16 ref.

Descriptors: *Flood peak, *Water level, *Routing, *Flood routing, *Model studies, Drainage area, Statistical models, Mathematical models, Hydrologic models, Boundary conditions, Civil engineering, Channel flow, Roughness coefficient, Flood plains, Flood waves, Embankments, Flood routing, Netherlands.

Flood level computations are discussed, referring to determination of water levels, discharge distribution and flow velocities in single and compound channels for the design of civil engineering works. The hydrological and hydraulic aspects discussed are external boundary conditions, internal boundary conditions, and computational models. External boundary conditions refer to either extreme upstream discharges, or downstream water levels, or to their joint occurrence depending on the location of the channel section. The application of one- or two-dimensional statistical models require homogeneous series of sufficient length. For various reasons, series are often inhomogeneous and too short. A procedure is discussed to eliminate inhomogeneities and to fill in missing data. It includes the sequential and efficient use of hydrologic and channel routing models. The application of this technique on a drainage area of 1500 square kilometers in the northern part of the Netherlands is dealt with. The results have led to considerable savings on civil engineering works. The internal boundary conditions comprise, aside from channel geometry and structure conditions, the hydraulic roughness of the cross profile, i.e. main channel and flood plains. Special attention is focused on the variation of the roughness of a sandy river bed during the passage of a flood wave. Empirical relations between bedform dimensions and hydraulic roughness based on recent investigations are dealt with. The effect of retarded adaptation of bedform dimensions on the development of the roughness is indicated. Its consequence for the hydrological boundary conditions for these type of computations is discussed. It is concluded that some commonly used statistical techniques oversimplify the boundary conditions for proper design. Finally, one- and two-dimensional numerical flood routing models, their limits and preference for application are discussed. Examples of their application for simulation of dam-break waves on the Rio Parana and for flood level computations for design of embankments along the Rhine branches in the Netherlands are presented. (See also W89-08863) (Author's abstract)
W89-08874

SHOT-NOISE MODEL OF STREAMFLOW,
Kentucky Univ., Lexington. Dept. of Statistics.
P. Todorovic, and D. A. Woolhiser.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 143-163, 5 fig, 18 ref.

Descriptors: *Hydrologic models, *Streamflow, *Model studies, *Streamflow forecasting, *Mathematical models, *Watersheds, Flood hydrographs, Temporal distribution, Variability, Climatic data, Geomorphology, Continuity equation, Rainfall-runoff relationships, Poisson Ratio.

A version of the classical shot-noise process, a special case of the filtered poisson process, is adopted in this paper as a streamflow model. Some of its basic properties may have potential in applications. Among the features investigated are its covariance function, the duration of its excursions above a certain threshold level, and its extreme values. The distribution function of its maximum value is obtained in an arbitrary time interval in a simple form. The principal concern is the physical base for application of the shot-noise process as a streamflow model. The climatic conditions and geomorphological features of a watershed which suggest that the shot-noise model may be feasible are discussed. In this respect, of central importance is the set of the discontinuity points of the process, which represents the building blocks of the entire structure. Their importance stems from the fact that they represent the occurrence times of those rainfall events which are capable of generating an effective runoff. A physically plausible explanation is provided for why this set of points represents a nonhomogeneous Poisson point process. (See also W89-08863) (Author's abstract)
W89-08875

RESPONSE CHARACTERISTICS OF TWO TROPICAL RIVER BASINS,
Utsunomiya Univ. (Japan). Dept. of Civil Engineering.
M. Hasebe, and M. Hino.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 165-174, 9 fig, 6 ref.

Descriptors: *River basins, *Model studies, *Tropical regions, *Hydrologic systems, *Watersheds, *Rainfall-runoff relationships, Hydrograph analysis, Drainage area, Regression analysis, Daily hydrographs.

A previously-derived method for hydrologic inverse detection, originally used for runoff data analysis, is extended to the hydrologic basin in a tropical zone. Applications of this method (Filter Separation Autoregression Model Method) have been carried out on the daily hydrologic data of the watershed of the Quai Yai River in Thailand, having a drainage area of 10,800 square kilometers, and the watershed of the Pampanga River in the Philippines, having a drainage area of 7,850 square kilometers. Generally, identification of the response characteristics of a system requires the data of both the input and the output from the rainfall-runoff system. Therefore, most of the hydrologic system analysis proposed have been developed by making use of the time series of both rainfall and runoff. A derivation is attempted, using only daily data, of not only the response characteristics of hydrologic subsystems, but also the effective daily rainfall components to the subsystems. The procedure of the present method is summarized as follows: (1) daily runoff time series are separated into time series of overland flow, interflow, and groundwater flow through numerical filters whose cutoff frequencies have been determined from the autoregressive coefficient and/or from the coherence gap between rainfall and runoff; (2) response characteristics of the hydrologic subsystem (overland flow, interflow, and groundwater flow) have been identified by fitting the autoregressive models to the time series of filtered runoff components; (3) daily rainfall time series have been estimated as the random input to the fitted autoregressive model. (See also W89-08863) (Author's abstract)
W89-08876

SYNTHETIC FLOW GENERATION WITH STOCHASTIC MODELS,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
L. H. Wijayaratne, and P. C. Chan.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 175-185, 5 tab, 7 ref.

Descriptors: *Model studies, *Mathematical models, *Streamflow forecasting, Watersheds, Statistical analysis, Markov process, Model testing, Comparison studies.

A first-order Markovian model for streamflow estimation is based on the three-parameter log normal distribution. This model was comparated with the Thomas-Fiering models, formulated using gamma distribution. Primary objectives of the study were: (1) to examine the satisfactory applicability of the proposed model, and (2) to investigate the importance of preserving the skewness in streamflow generation. Each model was used to generate sequences of annual mean flows for six watersheds. Average estimates of the statistical parameters were computed for the generated sequences and then compared with the historic values. To determine the effect of skewness, the probable maximum annual flows were estimated for three return periods using generated sequences and the magnitudes due to different models were compared. The results of the study indicate the importance of preserving the skewness in flow generation. In addition, they reveal that the proposed model can be satisfactorily used. (See also W89-08863) (Author's abstract)
W89-08877

REDUCTION OF UNCERTAINTIES IN THE FLOOD ESTIMATION IN THE CZECHOSLOVAK SECTION OF DANUBE RIVER,
Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
B. Minarik, and K. Martinka.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 187-195, 4 fig, 11 ref.

Descriptors: *Flood forecasting, *Czechoslovakia, *Danube River, *Watersheds, *Model studies, *Runoff forecasting, Algorithms, Estimating equations, River systems.

Because of various short- and long-term changes in the watershed, complicated hydrologic and hydraulic phenomena, and incomplete information about the process, many uncertainties are involved in real-time flood estimation and forecasting. Runoff estimates and short-term forecasts were formulated by the state space model. The adaptive filtering approach for the estimation of unknown parameters of the model was used. The algorithm was applied to the flood forecasting problem on the Danube system in Czechoslovakia. (See also W89-08863) (Author's abstract)
W89-08878

REAL-TIME FLOOD FORECASTING IN THE RIVER SECTION WITH UNGAGED TRIBUTARIES,
Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
B. Minarik.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 197-210, 2 fig, 11 ref.

Descriptors: *Flood forecasting, *Model studies, *River basins, Mathematical studies, Hydrologic models, Algorithm, Estimation, Czechoslovakia, Tributaries, Danube River.

The solution of the problem of the adaptive flood forecasting of the tributaries of large-scale water resource systems is described. The water resource system is divided into interbasins limited by significant specific profiles. The basic dynamic model of interbasin behavior is formulated by the state space model and solved by the adaptive Kalman filtration algorithm. Because of fast changes in the behavior of hydrological processes, the results of adaptive filtration typically exhibit delays and/or instability which grade hydrological forecasts. In real-time operation, therefore, the following procedure can be advantageous: (i) determination of the type of situation in which the hydrological process occurs, (ii) using, for the given type of hydrological situation, the corresponding basic model and values of the unknown parameters, and allowing the adaptive algorithm operate upon these values until the hydrological situation changes. The problem of the effective utilization of inaccurate and incomplete information on the behavior of hydrological processes in ungaged interbasins is solved by the two-level estimator. The algorithm is applied to real-time estimation and forecasting in the Czechoslovak section of the Danube River and other Czechoslovak rivers. (See also W89-08863) (Author's abstract)
W89-08879

FLOOD FORECASTING MODEL FOR CITANDUY RIVER BASIN,
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
K. N. Mutreja, Y. Au-Yeung, and I. Martono.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 211-220, 3 fig, 3 tab, 1 ref.

Descriptors: *Statistical models, *Flood forecasting, *River basins, Mathematical models, Water level recorders, Model studies, Gaging stations, Correlation analysis, Standard deviation, India, Comparison studies, Performance evaluation, Error analysis, Model studies.

Three flood forecasting models were analyzed in determining the optimal model for short-term flood forecasting for the Citanduy River Basin: (1) deterministic models, (2) mathematical models, and (3) statistical models. The statistical model was selected for its simplicity and accuracy. Concurrent hourly water level data of different base stations on different tributaries were used to develop a multiple correlation model for predicting stages at the forecasting station. To prepare a forecast, the input data needed are the hourly water levels at upstream locations called the base stations. Nine such locations, each equipped with an automatic water level recorder, were identified. The accuracy of the developed model was tested at each forecasting station with an independent data set, which were not used in developing the model. The forecasting accuracy was computed through the standard error of the estimate which was within 0.2 for all the forecasting stations, except at Cikawung which was 0.34. (See also W89-08863) (Author's abstract)
W89-08880

UNCERTAINTY AND CONFIDENCE IN ESTIMATING FLOOD FREQUENCIES FROM HURRICANES AND NORTHEASTERS AT UNGAGED COAST LOCATIONS: A NEW METHODOLOGY,
S. Dendrou, and B. Dendrou.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 221-230, 2 fig, 2 tab, 9 ref.

Descriptors: *Flood frequency, *Probabilistic process, *Flood profiles, *Coasts, *Storms, *Model studies, *Hurricanes, *Simulation analysis, Numerical analysis, Statistical studies, Storm surges, Flood levels, Statistical deviation, Flood frequency, Storm tides, Crest gages, Atlantic coast, North Carolina, Cape Hatteras, Estimating.

Coastal flooding along the Atlantic coast north of Cape Hatteras is caused by hurricanes and by northeasters. The best available tidal gage records are about 100 years long, so that estimation of flood levels of a 50-year return period and above is fraught with statistical error. This, together with the fact that hydrodynamically consistent flood profiles are usually required everywhere along the coastline of communities (not just at the gage), led to the development and use of the Joint Probability Method (JPM). This is a simulation-based method, whereby surges are simulated via a numerical hydrodynamic model. This model, in turn, is used to derive flood level statistics (frequencies) from statistics of the meteorological cause. Two elements necessary in applying the JPM method are a parameterization of the storm, and the extraction of statistics for these parameters from the meteorologic record. A synthetic sample of storms is then used to simulate representative surges covering the entire range of flood levels. In the 15 years of use of the JPM method the sample size of synthetic storms has been determined heuristically to vary from 300 to 800. The central question addressed is the optimal sample size of synthetic storms which will achieve the required accuracy without producing redundant information given the required accuracy of estimation of flood levels. The question is approached from the viewpoint of confidence intervals on the estimated frequency of exceedence of a given flood level. In contrast, gage analyses provide estimates of flood levels for given exceedence frequencies and the corresponding confidence intervals are given on the flood levels rather than on the frequencies. The flood frequency estimation error expressed as a confidence interval is complimented by determination of the accuracy of the estimate. This is achieved by use of a second-moment first order technique in conjunction with multiple simulations according to a stratified sampling scheme. Thus, the level of acceptable error controls the number of synthetic storms that need to be simulated (the sample size), and the required accuracy dictates which synthetic storms to simulate. (See also W89-08863) (Author's abstract)
W89-08881

STAGE-FREQUENCY CURVES FOR FLOODING DUE TO WAVE OVERTOPPING OF SEAWALLS,
Coastal Engineering Research Center, Vicksburg, MS.
T. A. Hardy.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 231-240, 4 fig, 8 ref.

Descriptors: *Flood stages, *Flood frequency, *Waves, *Sea walls, *Flooding, *Storms, *Model studies, Storm surges, Probabilistic process, Error analysis, Numerical analysis, Flood levels, Flood routing, Coasts, Boston, Massachusetts.

Curves relating flood levels with their frequency of occurrence were established for a coastal area just north of Boston. The principal cause of flooding is the overtopping of seawalls by storm waves. The project procedure involved the use of five modeling systems, including numerical storm surge, numerical spectral wave, physical wave overtopping, flood routing, and probability models. The main focus is on the probability model with the other four models only briefly described. The probability model had four main tasks: selection of flood events to be modeled, assignment of probability to these events, generation of stage-frequency curves, and providing a measure of error in the selection process. The maximum still water level which occurs during an event was chosen as the key variable. Surge time series extracted from historical data were combined randomly with a starting synthetic storm plus tide events. Events were selected from this ensemble for simulation and were assigned probabilities according to portion of a predetermined frequency curve. This frequency curve was transferred from Boston to the study area through the modeling process. Probable error bounds calculated for the selection process showed that the process could represent all possible events with a small number of simulated events. (Fish-PTT)
W89-08882

SPATIAL AND TEMPORAL FACTORS CONTROLLING OVERTOPPING OF COASTAL RIDGES,
Florida State Univ., Tallahassee. Dept. of Geology.
W. F. Tanner.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 241-248, 28 ref.

Descriptors: *Flooding, *Coasts, *Storms, *Waves, Storm surges, Dunes, Beach profiles, Wave crest, Wave wash, Bathymetry, Coriolis force, Climatology, Geologic control, Geologic history.

On low coasts there may be one of three basic sand or gravel ridge types: swash-built ridge, dune ridge, or storm surge ridge. The first of these commonly occurs in beach ridge plains, with up to 200 or more ridges, more or less parallel with each other. Common processes for storm overtopping include Langmuir superelevation, wave crossing, wave energy funneling (bathymetry), and Coriolis effects (each up to 1.0 meter or more), perhaps additive; all are short-term items (seconds to days). Edge waves make no energy and are unimportant. Long-term changes have climatological and/or geological controls. The number of controls and interactions are unknown. A few are listed to show some of the complications. In the last 5,000 years,

major changes have occurred rapidly at about 1,000-year intervals, long after ice sheet melting was over. Many major geological catastrophes have unknown periods and cannot be forecast. (See also W89-08863) (Author's abstract)
W89-08883

STATISTICAL ANALYSIS OF STORM TIDE ELEVATIONS FOR NEW ENGLAND COASTAL COMMUNITIES,
Stone and Webster Engineering Corp., Boston, MA.
Y. J. Tsai.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 249-256, 5 fig, 14 ref.

Descriptors: *Storm tides, *Flood forecasting, *Storm surges, *Coasts, *Floods, *Storms, *Model studies, Flood damage, Flood levels, Mathematical models, Synthetic hydrology, Statistical analysis, Probability distribution, Gage stations, Storm surges, New England, Flood recurrence interval, Insurance, Model testing.

Along the New England coast, most of the flooding damage is caused by winter storm or northeaster induced surges. Because the cause of flooding is unique, the Federal Insurance Administration has sponsored the development of a methodology to calculate water elevations using both the synthetic winter storm model and the storm surge model. Based on the methodology, determinations can be made of coastal flood levels having return intervals of 10, 50, 100, and 500 years. A statistical analysis has been adopted for the Flood Insurance Study using the results of storm surge modelling and the selected probability distribution model. The Pearson Type III Distribution was found to be a good probability distribution for storm tide elevations at the tide gage stations in New England with all the fits accepted by the chi-square test at the 95 percent confidence level. (See also W89-08863) (Author's abstract)
W89-08884

OPTIMIZING FLOOD PROTECTION FOR CYPRESS CREEK, HARRIS COUNTY, TEXAS,
Army Engineer District, Galveston, TX.
For primary bibliographic entry see Field 4A.
W89-08887

EFFECT OF EMBANKING ON RIVER AND SEA FLOODS,
International Inst. of Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 4A.
W89-08888

CATASTROPHIC FLOOD AND ITS CONTROL IN AUGUST, 1963 ON HAIHE RIVER BASIN OF CHINA,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Water Management.
For primary bibliographic entry see Field 4A.
W89-08896

DIFFERENCES BETWEEN GRAVEL AND SAND-BED RIVERS,
Simons and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W89-08935

RIVER DYNAMICS, FLOW REGIME AND SEDIMENT TRANSPORT,
R. D. Hey.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 17-37, 9 fig, 13 ref.

Descriptors: *River systems, *Geomorphology, *Channel morphology, *Streams, *Streamflow, *Sediment transport, *River flow, *River mechanics, Stream stabilization, Streambeds, Sediment erosion, Sediment distribution, Erosion, Deposition, Tectonics, Headwaters, Glacial streams.

Rivers are very effective erosional and depositional agents which, over periods of geological time, are responsible for major landscape modification. In the early phase of channel development morphological and sedimentological evidence indicates a complex interaction between cut and fill activity with periods of stability relatively rare. Subsequently, as the supply of transportable material declines, the river system tends towards a more stable regime condition. During periods of erosion and deposition the flow regime and sediment transport characteristics of the river are changed in a systematic manner in response to temporal and spatial changes in channel geometry and bed material size. Field data indicate that regime channel capacity is determined by the flow which collectively transports most material. When eroding or depositing, channel capacity is controlled by the flows which are responsible for most degradation or aggradation. In rivers originating in young mountain belts unstable conditions are likely to prevail in the headwaters with more stable conditions downstream. Rivers developed in tectonically stable areas which have been unaffected by glacial activity are more likely to exhibit regime type conditions. To manage any river system effectively it is necessary to have due regard for its degree of long-term stability. River response to any natural or imposed changes will depend on the degree of change and the prevailing stability of the channel. (See also W89-08934) (Author's abstract)
W89-08936

SEDIMENT SUPPLY TO UPLAND STREAMS: INFLUENCE ON CHANNEL ADJUSTMENT,
Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-08939

SEDIMENT SUPPLY, MOVEMENT AND STORAGE IN AN UNSTABLE GRAVEL-BED RIVER,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2J.
W89-08940

SEDIMENT BALANCE CONSIDERATIONS LINKING LONG-TERM TRANSPORT AND CHANNEL PROCESSES,
Northwest Hydraulic Consultants Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 2J.
W89-08942

STATIC ARMOUR LAYERS BY SELECTIVE EROSION,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08943

FORMATION OF A COARSE SURFACE LAYER AS THE RESPONSE TO GRAVEL MOBILITY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W89-08944

BED LOAD DISCHARGE EQUATION FOR STEEP MOUNTAIN RIVERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08949

FIELD MEASUREMENTS IN A GRAVEL-BED RIVER WHICH CONFIRM THE THEORY OF WHITE ET AL.,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 2J.
W89-08950

SEDIMENT TRANSPORT IN STEP-POOL STREAMS,
Ministry of Works and Development, Lower Hutt (New Zealand). Central Labs.
For primary bibliographic entry see Field 2J.
W89-08952

BED LOAD TRANSPORT MEASUREMENTS BY THE VORTEX-TUBE TRAP ON VIRGINIO CREEK, ITALY,
Florence Univ. (Italy). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08953

BED LOAD TRANSPORT IN DESERT FLOODS: OBSERVATION IN THE NEGEV,
Hebrew Univ. of Jerusalem (Israel). Dept. of Physical Geography.
For primary bibliographic entry see Field 2J.
W89-08954

INFLUENCE OF LARGE SUSPENDED-SEDIMENT CONCENTRATIONS IN RIVERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08955

SUSPENDED LOAD IN GRAVEL-BED RIVERS: UK EXPERIENCE,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-08956

ENERGY DISSIPATION RATE APPROACH IN RIVER MECHANICS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2J.
W89-08957

EXTREMAL HYPOTHESES APPLIED TO RIVER REGIME,
Hydraulics Research Ltd., Wallingford (England).
For primary bibliographic entry see Field 2J.
W89-08958

PROBLEMS OF BED LOAD TRANSPORT IN BRAIDED GRAVEL-BED RIVERS,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W89-08959

INTERACTION OF BED LOAD TRANSPORT WITH BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2J.
W89-08960

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1986,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08981

GROUND-WATER-SURFACE WATER RELATIONS IN THE FLATHEAD RIVER VALLEY NEAR THE PROPOSED CABIN CREEK COAL MINE, BRITISH COLUMBIA, CANADA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08982

HYDROLOGIC HAZARDS ALONG SQUAW CREEK FROM A HYPOTHETICAL FAILURE

OF THE GLACIAL MORAINE IMPOUNDING CARVER LAKE NEAR SISTERS, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen, K. M. Scott, J. E. Costa, and L. L. Orzol.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-41, 1987. 48p, 19 fig, 3 tab, 26 ref, append.

Descriptors: *Snowmelt, *Flood profiles, *Carver Lake, *Squaw Creek, *Dam failure, *Oregon, *Glaciers, Sisters, Flood forecasting, Hydrologic models, Floods, Ice, Model studies, Dams.

A hydrologic hazard exists that could create a large-magnitude, but short-duration, flood in the Squaw Creek drainage and inundate areas in and around the community of Sisters, Oregon. There is a 1 to 5% probability that Carver Lake, located at elevation 7,800 ft above sea level on the east slope of South Sister mountain, Oregon, could catastrophically empty. At the U.S. Geological Survey gage (14075000) on Squaw Creek between Carver Lake and Sisters, the magnitude of the breakout flood would be 10 times that of a 1% probability meteorological flood. In Sisters, the magnitude of the breakout flood would be about five times that of a 1% probability meteorological flood. Several conditions at Carver Lake indicate the potential hazard: (1) The lake is very deep for its size; the lake contains 740 acre-ft of water and is more than 100 ft deep; (2) There is a probability that a large magnitude avalanche and consequent overtopping of the lake could occur. There are steep slopes of unstable volcanic rock and an extensively cravassed glacier located above the lake; (3) The moraine dam confining the lake is steep-faced, rendering the dam unstable, and unvegetated making it highly erodible; (4) Large amounts of readily erodible material available for transport would increase the magnitude of a large flood and keep the flood from attenuating in the steep reaches of the Squaw Creek channel; (5) and, Geologically, there is a greater than normal possibility for the area to become seismically active. Earthquakes could cause rock and ice to fall into the lake. A one-dimensional unsteady-state streamflow model was used to route a hypothetical flood down the Squaw Creek drainage. This scenario creates a starting hydrograph with a peak of 180,000 cu ft/sec. The ensuing hypothetical flood would incorporate readily erodible debris and sediments in the steep canyons, increasing the total volume of the flood by a factor of two. As the peak emerges from the steeper slopes into a more gently sloping valley 8 miles from the lake, the peak would attenuate to 47,000 cu ft/sec. At the Geological Survey gage at river mile 26.6, the peak would attenuate to 21,000 cu ft/sec. In Sisters on the alluvial fan, at about 20 miles downstream from the lake, the peak would continue to attenuate to 9,800 cu ft/sec. (Lantz-PTT)
W89-08986

FLUOROMETRIC PROCEDURES FOR DYE TRACING,
For primary bibliographic entry see Field 7B.
W89-09013

COMPUTATION OF WATER-SURFACE PROFILES IN OPEN CHANNELS,
J. Davidian.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Techniques of Water-Resources Investigations, Book 3: Applications of Hydraulics, Chapter A15, 1984. 48p, 35 fig, 20 ref.

Descriptors: *Surface water, *Open channels, *Hydraulic properties, *Flow profiles, Bridges, Culverts, Embankments, Discharge, Flood flow, Floodways.

The standard step-backwater method of computing water surface profiles is described. The hydraulic principles and assumptions are reviewed, and the field data requirements are described. Certain special cases of backwater curves and certain special field conditions (such as verified reaches, short reaches, crossing profiles, transitions between inbank and overbank flow conditions, flow at tributaries, flow past islands, and multichannel flows) are discussed. The technique is used to establish or extend stage discharge ratings; to define areas which will be inundated by flood flows of a given frequency; and to compute profiles through various reaches, including multichannel flows, and past control structures such as bridges, culverts, and road embankments. A brief description of analysis of floodways and effects of encroachments is also presented. (Lantz-PTT)
W89-09014

RECHARGE OF SHALLOW AQUIFERS THROUGH TWO EPHEMERAL-STREAM CHANNELS IN NORTHEASTERN WYOMING, 1982-83,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09018

SUSPENDED SEDIMENT IN MINNESOTA STREAMS,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09019

EFFECT OF GLACIER ABLATION ON THE SNETTISHAM HYDROELECTRIC PROJECT, LONG LAKE AND CRATER LAKE BASINS, ALASKA WITH A SECTION ON STREAMFLOW RECORDS,
Geological Survey, Anchorage, AK. Water Resources Div.
C. E. Sloan, P. A. Emery, D. Fair, and R. D. Lamke.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4315, 1986. 22p, 6 fig, 9 tab, 1 plate, 8 ref.

Descriptors: *Glaciers, *Long Lake, *Crater Lake, *Streamflow, *Hydroelectric plants, *Melting, Glacial streams, Glaciohydrology, Ice, Alaska, Runoff volume.

Long Lake Basin in the Snettisham Project Area southeast of Juneau, Alaska, yields water used for the production of hydroelectric power. Development of adjacent Crater Lake is planned to increase the Project's generating capacity. Estimates of the hydroelectric potential of the lakes are based on streamflow records which are influenced by glaciers that cover 25% of the combined basins. Analysis of streamflow records shows that the quality and extent of records in the area are sufficient to predict flow from the Crater Creek basin with a fairly high degree of confidence. Comparison of aerial photographs indicates that glacier ablation and recession have been continuous since at least 1929. Estimates of ice-volume change from photogrammetric measurements indicate that less than 2.5% of the average runoff from the basins of Long and Crater Lakes has been from reduction in glacier-ice storage. (Author's abstract)
W89-09021

EFFECT OF BANK PROTECTION MEASURES, STEHEKIN RIVER, CHELAN COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4D.
W89-09022

AREAL AND TEMPORAL VARIATIONS IN THE QUALITY OF SURFACE WATER IN HYDROLOGIC ACCOUNTING UNIT 120301, UPPER TRINITY RIVER BASIN, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09023

WATER QUALITY IN THE ST. CROIX NATIONAL SCENIC RIVERWAY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-09024

ESTIMATING ANNUAL SUSPENDED-SEDIMENT LOADS IN THE NORTHERN AND CENTRAL APPALACHIAN COAL REGION,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09035

ANALYSES OF FLOOD-FLOW FREQUENCY FOR SELECTED GAGING STATIONS IN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
R. D. Benson, E. B. Hoffman, and V. J. Wipf.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4217, 1985. 202p, 1 fig, 112 tab, 6 ref.

Descriptors: *Flood flow, *Flood frequency, *Hydrologic data collections, *South Dakota, Gaging stations, Data collections, Flood peak, Stream gages.

Analyses of flood flow frequency were made for 111 continuous-record gaging stations in South Dakota with 10 or more years of record. The analyses were developed using the log-Pearson Type III procedure recommended by the U.S. Water Resources Council. The procedure characterizes flood occurrence at a single site as a sequence of annual peak flows. The magnitudes of the annual peak flows are assumed to be independent random variables following a log-Pearson Type III probability distribution, which defines the probability that any single annual peak flow will exceed a specified discharge. By considering only annual peak flows, the flood-frequency analysis becomes the estimation of the log-Pearson annual-probability curve using the record of annual peak flows at the site. The recorded data are divided into two classes: systematic and historic. The systematic record includes all annual peak flows determined in the process of conducting a systematic gaging program at a site. In this program, the annual peak flow is determined for each and every year of the program. The systematic record is intended to constitute an unbiased and representative sample of the population of all possible annual peak flows at the site. In contrast to the systematic record, the historic record consists of annual peak flows that would not have been determined except for evidence indicating their unusual magnitude. Flood information acquired from historical sources almost invariably refers to floods of noteworthy, and hence extraordinary, size. Although historic records form a biased and unrepresentative sample, they can be used to supplement the systematic record. (Author's abstract)
W89-09037

STREAMFLOW STATISTICS AND DRAINAGE-BASIN CHARACTERISTICS FOR THE PUGET SOUND REGION, WASHINGTON, VOLUME I: WESTERN AND SOUTHERN PUGET SOUND,
Geological Survey, Tacoma, WA. Water Resources Div.
J. R. Williams, H. E. Pearson, and J. D. Wilson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-144-A, 1985. 330p, 1 fig, 2 tab, 1 plate, 15 ref.

Descriptors: *Water resources data, *Data collections, *Streamflow, *Hydrologic data collections, *Puget Sound, *Washington, Drainage areas, Stream gages, Low flow, High flow, Flow duration, Flood frequency, Stream discharge.

This report presents streamflow data and drainage basin characteristics for 133 sites from Cape Flattery through the Green River basin near Seattle,

Washington. All gaging stations with 5 or more yr of record (through 1979) are included. The data include monthly and annual mean discharges and their statistics, low-flow and high-flow analyses, flow duration, and flood frequency. For stations having 10 or more years of monthly mean discharges, results of additional statistical analyses are given. The statistics, computed from the monthly and annual mean discharges, are the mean, maximum minimum, standard deviation, coefficient of skewness, coefficient of variation, percentage of the average discharge, and the statistics of the logarithms of the flows. Also listed are monthly and annual mean discharge exceedence probabilities based on log-Pearson Type III analyses. The magnitudes of the monthly and annual mean discharges for each year are assumed to be independent random variables that follow the log-Pearson Type III probability distribution. For some stations, 10 years or more of record have been gathered both before and after significant regulation on the stream. In those cases, the statistics have been computed using the unregulated or natural flow first, and then using the regulated years only. A comparison of the two sets of statistics gives a good measure of the effect of regulation. (See also W89-09045) (Author's abstract)
W89-09044

STREAMFLOW STATISTICS AND DRAINAGE-BASIN CHARACTERISTICS FOR THE PUGET SOUND REGION, WASHINGTON. VOLUME II: EASTERN PUGET SOUND FROM SEATTLE TO THE CANADIAN BORDER,
Geological Survey, Tacoma, WA. Water Resources Div.
J. R. Williams, H. E. Pearson, and J. D. Wilson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open- File Report 84-144-B, 1985. 420p, 1 fig, 2 tab, 1 plate, 15 ref.

Descriptors: *Water resources data, *Streamflow, *Hydrologic data collections, *Washington, *Puget Sound, *Drainage area, *Data collections, Stream gages, Low flow, High flow, Flow duration, Flood frequency, Stream discharge.

This report presents streamflow data and drainage-basin characteristics for 166 sites from the Cedar River, near Seattle, to the Canadian border. All gaging stations with 5 or more yr of record (through 1979) are included. The data include monthly and annual mean discharges and their statistics, low-flow and high-flow analyses, flow duration and flood frequency. For stations having 10 or more years of monthly mean discharges, results of additional statistical analyses are given. The statistics, computed from the monthly and annual mean discharges, are the mean, maximum, minimum, standard deviation, coefficient of skewness, coefficient of variation, percentage of the average discharge, and the statistics of the logarithms of the flows. Also listed are monthly and annual mean discharge exceedence probabilities based on log-Pearson Type III analyses. The magnitudes of the monthly and annual mean discharges for each year are assumed to be independent random variables that follow the log-Pearson Type III probability distribution. For some stations, 10 years or more of record have been gathered both before and after significant regulation on the stream. In those cases, the statistics have been computed using the unregulated or natural flow first, and then using the regulated years only. A comparison of the two sets of statistics gives a good measure of the effect of regulation. (See also W89-09044) (Author's abstract)
W89-09045

MAGNITUDE AND FREQUENCY OF HIGH FLOWS OF UNREGULATED STREAMS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
P. R. Jordan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-453, 1984. 45p, 7 fig, 6 tab, 16 ref.

Descriptors: *High flow, *Streamflow, *Flood frequency, *Kansas, Flow profiles, Hydrologic data, Stream gages, Mathematical studies, Regression analysis, Rainfall, Evaporation.

Information on high flow magnitude and frequency is needed for hydrologic evaluation of such factors as flood control storage and dam safety. High flow information given in this report is for streamflows unaffected by major regulation, such as by large reservoirs. High flow magnitude and frequency data are given for 91 streamflow gaging stations throughout Kansas. Results of frequency calculations are given for durations of high flow of 1, 3, 7, 15, 30, 60, 90, 120, and 183 consecutive days. Accuracy of the magnitude-frequency values is influenced by the variability of flow, the number of years of flow record, and the recurrence interval calculated. High flow magnitude and frequency for ungaged sites can be estimated from regression equations using significant drainage basin characteristics of contributing-drainage area; 50-yr, 24-hr rainfall; and free-water-surface evaporation. Standard errors of estimate for ungaged sites on ungaged streams range from 31% to 49%, generally increasing with recurrence interval. If an ungaged site is near a gaging station having 10 or more yr of record on the same stream, the data for the gaging station may be used to improve the regression estimates. (Author's abstract)
W89-09049

WATER-RESOURCES STUDIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1983, TO JUNE 30, 1984,
Geological Survey, Salt Lake City, UT.
L. S. Hamblin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-585, 1984. 50p.

Descriptors: *Water resources research, *Water resources data, *Utah, State jurisdiction, Federal jurisdiction, Research priorities, Groundwater, Surfac waters, Geohydrology, Data collections.

Progress on water resources studies in Utah by the U.S. Geological Survey during the period July 1, 1983 to June 30, 1984 is summarized. Much of the work was done in cooperation with the State of Utah and local agencies. The program in Utah during the reporting period consisted of 21 projects; a discussion of each project, including 2 projects discontinued during the year, is given. Short descriptions are given at the end of the report for three proposed projects to be started on or after July 1, 1984. (Lantz-PTT)
W89-09060

WATER QUALITY DATA FOR SELECTED STREAMS TRIBUTARY TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09068

INSTRUMENTATION FOR MEASURING AND RECORDING STREAMFLOW DATA AT RIVER-CONTROL STRUCTURES.
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09069

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. L. Green.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-770, 1983. 120p, 4 fig, 5 tab, 230 ref.

Descriptors: *Water resources data, *Groundwater, *Surface water, *Wyoming, *Maps, *Water quality, *Hydrologic data collections, *Data collections, Streamflow, Reservoirs, Water level, Groundwater, Wells.

Lists and location maps of streamflow and reservoir stations, crest stage partial record stations, water quality stations, sediment stations, and groundwater observation wells where data are currently being collected in Wyoming are presented. Water resources appraisal projects in Wyoming are described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water resources investigations with those of other agencies. This report is one phase of that coordination effort, and serves as an annual progress report to cooperators and the public. (Author's abstract)
W89-09079

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1981,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. R. White, and J. G. Wells.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-772, 1983. 38p, 4 fig, 19 ref.

Descriptors: *Surface water, *Groundwater, *Water resources data, *New Mexico, *Water quality, *Streamflow, Groundwater budget, Groundwater quality, Storm runoff, Floods, Hydrologic budget, Surface water, Sediment transport.

The Water Resources Division of the U.S. Geological Survey investigates the occurrence, quantity, quality, distribution, and movement of the Nation's surface and underground waters, and coordinates Federal water data acquisition activities. During fiscal year 1981, the New Mexico District had 40 active projects, released 19 reports, and answered hundreds of requests of water-related information. Investigations included the following: (1) chemical quality of surface water in New Mexico; (2) chemical quality of groundwater in New Mexico; (3) sediment transport in New Mexico streams; (4) surface water supply; (5) surface water diversions for irrigation; (6) streamflow characteristics; (7) effect of urban development on storm runoff; (8) inundation from floods; (9) effects of groundwater pumping; (10) long-term monitoring of groundwater levels; (11) groundwater and surface water relationships; (12) consumptive use by phreatophytes; (13) hydrologic impacts of energy development; and (14) groundwater supplies. (Lantz-PTT)
W89-09080

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEBRASKA, 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
J. E. McKinney, and R. A. Engberg.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-181, 1985. 33p, 5 fig, 2 tab, 21 ref.

Descriptors: *Water resources data, *Hydrologic data, *Data collections, *Research priorities, *Nebraska, Water management, Hydrologic studies.

The State of Nebraska has a greater abundance of water than most of the surrounding States. The major water issues in the State concern the management of these water resources in regard to their availability areally across the State and temporally over the changing seasons and cycles of weather. Management also concerns the protection of the supply of water from deterioration through contamination. The U.S. Geological Survey (USGS) in Nebraska began providing data to allow for better management of the State's water near the end of the 19th Century. Since then the USGS activities have continued and have included the monitoring of hydrologic conditions, detailed studies to describe the hydrology of specific areas, and

studies to add to the basic scientific knowledge of hydrology. Projects in all these areas continue. The work has been supported through Federal funding, through support from other Federal agencies, and through cooperative programs with many State and local agencies. This report summarizes these activities which are ongoing in the State of Nebraska. (Lantz-PTT)
W89-09087

DRAINAGE AREAS IN THE BIG SIOUX RIVER BASIN IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09092

POST-ERUPTION CHANGES IN CHANNEL GEOMETRY OF STREAMS IN THE TOUTLE RIVER DRAINAGE BASIN, 1980-82, MT. ST. HELENS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09093

WATER RESOURCES ACTIVITIES IN LOUISIANA DISTRICT FISCAL YEAR 1985,
Geological Survey, Baton Rouge, LA. Water Resources Div.
R. A. Herbert, and E. A. Ellsworth.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-415, 1985. 64p, 3 fig, 3 append.

Descriptors: *Water resources, *Data collections, *Louisiana, *Research priorities, *Hydrologic data, Information exchange.

Water resources activities of the U.S. Geological Survey (USGS) in Louisiana consist of collecting water resources data and conducting interpretive hydrologic investigations and research. The water resources data and the results of the interpretive investigations are published or released by either the USGS or by cooperating agencies. The USGS water resources activities in Louisiana for the 1985 fiscal year (October 1, 1984 to September 30, 1985) are described, including data collection and dissemination, water resources appraisals (interpretive studies) and research. (Lantz-PTT)
W89-09094

SEDIMENTATION AND WATER QUALITY IN THE WEST BRANCH SHADE RIVER BASIN, OHIO, 1984 WATER YEAR,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09099

GROUND-WATER AND SURFACE-WATER-LEVEL DATA AT RINDGE TRACT ON THE STOCKTON DEEP WATER SHIP CHANNEL, SAN JOAQUIN COUNTY, CALIFORNIA, 1983-84,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09101

ANALYSIS OF SURFACE-WATER DATA NETWORK IN KANSAS FOR EFFECTIVENESS IN PROVIDING REGIONAL STREAMFLOW INFORMATION--WITH A SECTION ON THEORY AND APPLICATION OF GENERALIZED LEAST SQUARES,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-09105

HYDROLOGIC MONITORING IN THE AREA OF THE TENNESSEE-TOMBIGBEE WATERWAY, MISSISSIPPI-ALABAMA FISCAL YEAR 1985,
Geological Survey, Jackson, MS. Water Resources Div.
F. Morris.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-493, October 1986. 311p, 10 fig, 25 ref, 3 append.

Descriptors: *Inland waterways, *Water resources data, *Hydrologic data collections, *Tennessee-Tombigbee Waterway, *Environmental effects, *Data collections, *Alabama, *Mississippi, Groundwater level, Groundwater quality, Surface water, Water quality, Disposal sites, Monitoring, Water resources development.

This report, the twelfth in a series of annual reports presenting hydrologic data collected from the area of the Tennessee-Tombigbee Waterway, covers the fiscal year ending September 30, 1985. The Waterway, under construction since the early 1970s, was completed in January 1985. Included are data on groundwater levels and quality; surface water stage, discharge, and quality; and disposal area water levels, water quality, and rainfall. These data were obtained at the request of the U.S. Army Corps of Engineers, Mobile and Nashville Districts, as part of comprehensive programs to monitor the hydrologic effects of construction and operation of the Waterway. (Author's abstract)
W89-09121

METHOD FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF UNGAGED STREAMS IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
L. D. Arihood, and D. R. Glatfelter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-323, 1986. 32p, 8 fig, 4 tab, 1 plate, 10 ref.

Descriptors: *Low flow, *Streamflow, *Indiana, Regression analysis, Mathematical equations, Flow duration, Mathematical studies, Stream discharge, Drainage area, Geohydrology.

Equations for estimating the 7-day, 2-yr and 7-day, 10-yr low flows at sites on ungaged streams are presented. Regression analysis was used to develop equations relating basin characteristics and low flow characteristics at 82 gaging stations. Significant basin characteristics in the equations are contributing drainage area and flow duration ratio, which is the 20% flow duration divided by the 90% flow duration. Flow duration ratio has been regionalized for Indiana on a plate. Ratios for use in the equations are obtained from this plate. Drainage areas are determined from maps or are obtained from reports. The predictive capability of the method was determined by tests of the equations and of the flow duration ratios on the plate. The accuracy of the equations alone was tested by estimating the low flow characteristics at 82 gaging stations where flow duration ratio is already known. In this case, the standard errors of estimate for 7-day, 2-yr and 7-day, 10-yr low flows are 19% and 28%. When flow duration ratios for the 82 gaging stations are obtained from the map, the standard errors are 46% and 61%. However, when stations with drainage areas < 10 sq mi are excluded from the test, the standard errors reduce to 38% and 49%. Standard errors increase when stations with small basins are included, probably because some of the flow duration ratios obtained for these small basins are incorrect. Local geology and its effect on the ratio are not adequately reflected on the plate, which shows the regional variation in flow duration ratio. In all the tests, no bias is apparent areally, with increasing drainage area or with increasing ratio. Guidelines and limitations should be considered when using the method. The method can be applied only at sites in the northern and the central physiographic zones of the state. Low flow characteristics cannot be estimated for regulated streams unless the amount of regulation is known so that the estimated low flow characteristic can be adjusted. The method is most accurate for sites with drainage areas ranging from 10 to 1,000 sq mi and for predictions of 7-day, 10-yr low flows ranging from 0.5 to 340 cu ft/sec. (Author's abstract)
W89-09129

DATA ON THE SOLUTE CONCENTRATION WITHIN THE SUBSURFACE FLOWS OF LITTLE LOST MAN CREEK IN RESPONSE TO A TRANSPORT EXPERIMENT, REDWOOD NATIONAL PARK, NORTHWEST CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09130

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1985 THROUGH SEPTEMBER 1986,
Geological Survey, Helena, MT. Water Resources Div.
R. S. Roberts.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-421W, September 1986. 81p, 9 fig, 4 tab.

Descriptors: *US Geological Survey, *Water resources data, *Montana, *Data acquisition, *Hydrologic studies, Research priorities, Economic aspects.

Water resources programs and activities of the U.S. Geological Survey in Montana consist principally of hydrologic data collection (6 projects); local areal, or statewide hydrologic investigation (12 projects); and research (1 project). The work is supported by direct Federal funding, by transfer of funds from other federal agencies, and by joint funding agreements with state or local agencies. The projects funded for fiscal yr 1986, the operations of the Montana District, water conditions during the preceding year, activities in addition to regular programs, sources of publications and information are described, and reports published or released during the preceding 5 yr are listed. (Author's abstract)
W89-09132

FLOOD OF APRIL 5-7, 1984, IN NORTHEASTERN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
M. O. Philips, and R. D. Schopp.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-423W, 1986. 112p, 5 fig, 5 tab, 15 ref.

Descriptors: *Floods, *New Jersey, *Rainfall, *Hydrologic data collections, *Flood peak, *Flood discharge, *Flood damage, New York, Hydrologic studies, Streamflow, Water level, Pasaic River.

This report documents hydrologic and meteorologic aspects of flooding in northeastern New Jersey and nearby New York during April 5-7, 1984. Recorded rainfall varied from 2 inches to slightly more than 8 inches within the study area. Peak stages and discharges at 46 streamflow-gaging sites are tabulated and compared to previous maximums. Thirteen gages in the Passaic River basin recorded new peaks of record. Flood-crest elevations are presented for nine stream reaches in the Passaic River basin where the most severe flooding occurred. The flooding caused 3 deaths, $250 million in property damages, and forced 6,000 people from their homes. (Author's abstract)
W89-09134

ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WATER-RESOURCES DIVISION IN NORTH CAROLINA, 1986,
Geological Survey, Raleigh, NC. Water Resources Div.
J. F. Turner, and R. J. Deckard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-226, 1986. 69p, 12 fig.

Descriptors: *Water resources data, *Water resources development, *North Carolina, *Data acquisition, *Hydrologic data, Surface water, Groundwater, Information exchange, Economic aspects, Groundwater depletion, Groundwater level.

Water resources programs conducted by the U.S. Geological Survey in the state of North Carolina during 1985 and proposed programs for 1986 are described. This is the first in a series of biennial progress reports on Survey activities in the state. Activities such as gathering, interpreting and publishing hydrologic data and scientific information in support of state and local water resources planning, management, and regulatory programs are presented. The water resources programs described are funded through cooperative agreements with state and local agencies and through special agreements with other federal agencies. Cooperative programs are reviewed annually to insure that state, local and national priorities are being met. Groundwater withdrawals are estimated to have produced water level declines of 150 ft and more for large areas of the northeast and central Coastal Plain. Future demands for water quality and quantity are discussed. (Lantz-PTT)
W89-09136

WATER RESOURCES ACTIVITIES IN FLORIDA, 1985-86,
Geological Survey, Tallahassee, FL. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-150, 1986. 95p. Edited by Mildred E. Glenn.

Descriptors: *Water resources data, *Data collections, *Florida, *Data acquisition, Surface water, Groundwater, Hydrological data, Water quality.

This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1985-86. These activities are part of the Federal program of appraising the Nation's water resources. Water resources appraisals in Florida are highly diversified, ranging from hydrologic records networks to interpretive appraisals of water resources and applied research to develop investigative techniques. Thus, water resource investigations range from basic descriptive water-availability studies for areas of low-intensity water development and management to sophisticated cause and effect studies in areas of high-intensity water development and management. The interpretive reports and records that are products of the investigations are a principal hydrologic foundation upon which the plans for development, management, and protection of Florida's water resources may be based. (Lantz-PTT)
W89-09140

SIMULATION OF THREE LAHARS IN THE MOUNT ST. HELENS AREA, WASHINGTON USING A ONE-DIMENSIONAL, UNSTEADY-STATE STREAMFLOW MODEL,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09143

FLOODING AND SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. R. Kolva, and G. F. Koltun.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4053, 1987. 33p, 12 fig, 5 tab, 26 ref.

Descriptors: *Coal mining, *Flooding, *Sedimentation, *Wheeling Creek, *Ohio, Floods, Streamflow, Flood peak, Sediment transport, Flood frequency, Channel scour.

The Wheeling Creek basin, which is located primarily in Belmont County, Ohio, experienced three damaging floods and four less severe floods during the 29-month period from February 1979 through June 1981. Residents of the basin became concerned about factors that could have affected the severity and frequency of out-of-bank floods. In response to those concerns, a study was conducted to estimate peak discharges and recurrence intervals for the seven floods of interest, provide information on current and historical mining-related stream channel fill or scour, and examine storm-period subbasin contributions to the sediment load in Wheeling Creek. Streamflow data for adjacent basins, rainfall data, and in two cases, flood profile data were used in conjunction with streamflow data subsequently collected on Wheeling Creek to provide estimates of peak discharge for the seven floods that occurred from February 1979 through June 1981. Estimates of recurrence intervals were assigned to the peak discharges on the basis of regional regression equations that relate selected basin characteristics to peak discharges with fixed recurrence intervals. These estimates indicate that a statistically unusual number of floods with recurrence intervals of 2 yr or more occurred within that time period. Excavations of stream bottom materials were made near the three main stem cross-section locations and near the mouth of Jug Run. The bottom materials were examined for evidence of recently deposited sediments of mining-related origin. The only evidence of appreciable mining-related sediment deposition was found at Jug Run, and, to a lesser extent, at one main stem site. (Lantz-PTT)
W89-09179

FLOOD HAZARDS ALONG THE TOUTLE AND COWLITZ RIVERS, WASHINGTON, FROM A HYPOTHETICAL FAILURE OF CASTLE LAKE BLOCKAGE,
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen, and L. L. Orzol.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4055, 1987. 29p, 6 fig, 3 tab, 22 ref.

Descriptors: *Flood damage, *Toutle River, *Cowlitz River, *Castle Lake, *Earthquakes, *Debris dams, *Dam failure, Flood peak, Washington, Streamflow, Detritus, Model studies, Flood magnitude.

A recent evaluation of groundwater and material in the blockage impounding Castle Lake shows that the blockage is potentially unstable against failure from piping due to heave and internal erosion when groundwater levels are seasonally high. There is also a remote possibility that a 6.8 or greater magnitude earthquake could occur in the Castle Lake area when groundwater levels are critically high. If this situation occurs, the debris blockage that confines Castle Lake could breach from successive slope failure with liquefaction of a portion of the blockage. A dam-break computer model was used to simulate discharge through a hypothetical breach in the Castle Lake blockage that could be caused by failure by heave, internal erosion, or liquefaction. Approximately 18,500 acre-ft of stored water would be released from an assumed breach that fully developed to a 1,000-ft width over a 15-minute time period. The resulting flood, incorporating 3.4 x 10 to the 6th power cu yd of the debris blockage, would reach a peak magnitude of 1,500,000 cu ft/s (cubic feet per second). The flood is also assumed to incorporate an additional 137x10 to the 6th power cu yd of saturated debris material from downstream deposits. Flow is considered to be hyperconcentrated with sediment throughout the course of the flood. The hypothetical hyperconcentrated flow is routed downstream, superimposed on normal winter flood flows by use of a one-dimensional unsteady-state numerical streamflow simulation model. From a starting magnitude of 1,500,000 cu ft/s, the peak increases to 2,100,000 cu ft/s at N-1 Dam (12 mi downstream) and attenuates to 1,200,000 cu ft/s at Kid Valley (25 mi downstream), to 100,000 cu ft/s at Longview and the confluence of the Columbia River (65 mi downstream). From time of breach, the flood peak would take 2.2 hr to reach Toutle, 3.8 hr to reach Castle Rock, and 8.5 hr to reach Longview. Communities of Toutle, Castle Rock, Kelso, and Longview would experience extreme to moderate flooding for this scenario. (Author's abstract)
W89-09180

APPRAISAL OF STORM-WATER QUALITY NEAR SALEM, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
T. L. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4064, 1987. 29p, 6 fig, 7 tab, 24 ref.

Descriptors: *Urban runoff, *Water pollution sources, *Storm water, *Storm runoff, *Water quality, *Salem, *Oregon, Suspended sediment, Lead, Biochemical oxygen demand, Turbidity, Phosphorus, Nitrogen, Precipitation, Ammonia, Sulfates, Chlorides.

Stormwater runoff for the period December 1979 to May 1981, at 13 sites (12 basins) in the vicinity of Salem, Oregon, was sampled and analyzed for water quality. Constituent concentrations for urban storm water were relatively small when compared to samples from Portland and Medford, Oregon and to samples from Denver, Colorado. The data indicated that levels of suspended sediment, ultimate CBOD (carbonaceous biochemical oxygen demand), and total lead increased with increased urbanization. Much of the suspended sediment and related turbidity result from transport of basin soils rather than from the wash-off of dry fallout solids from impervious areas. Because of small chemical concentrations and winter high flow and low temperature conditions in the Willamette River, Salem storm water probably has little effect on biological or on most chemical conditions in the Willamette River. An analysis of data from a stormwater detention pond (originally designed to reduce peak flows) indicated that the facility was about 47% efficient in reducing suspended sediment loads. The facility also reduced such sediment-related constituent loads as total lead and total phosphorus. Total Kjeldahl nitrogen and ultimate CBOD loads that are transported mostly in the dissolved phase were not measurably affected by the detention pond. Precipitation samples collected at one site for a year were found to be acidic, with a median pH of 4.6. Median total lead concentration was 8 micrograms/L (ug/L) in precipitation, whereas the median total lead concentration in runoff from the 12 basins ranged from 8 to 110 ug/L. The median dissolved ammonia concentration in precipitation was larger than the median dissolved ammonia concentration at all 13 sites. In contrast, the median total Kjeldahl nitrogen concentration in precipitation samples was about half the median for streamwater concentrations. Median ratios of sulfate to chloride and nitrate to chloride in precipitation were much higher than ratios expected for sea water, suggesting anthropogenic sources for sulfate and nitrate. (Author's abstract)
W89-09185

HYDROLOGY OF AREA 58, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Chaney, G. Kuhn, and T. Brooks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 85-479, January 1987. 103p, 39 fig, 2 tab, 166 ref.

Descriptors: *Hydrologic budget, *Environmental effects, *Coal mining, *Colorado, *Utah, *Geohydrology, Precipitation, Groundwater recharge, Snowmelt, Water quality, Dissolved solids, Calcium, Chromium, Iron, Manganese, Lead, Colorado River, Semiarid lands, Groundwater quality.

Hydrologic information and analyses are needed to aid in decisions to lease Federally owned coal and

to prepare the necessary environmental assessments and impact study reports. The report, which is one of a series covering the nation's coal areas, presents information thematically by describing single hydrologic topics through the use of brief texts and accompanying maps, graphs, or other illustrations. The topics encompass the complete physical and hydrologic setting of Area 58, located primarily in west-central Colorado in the Southern Rocky Mountain and Colorado Plateau physiographic provinces. The area consists of 13,132 sq mi of diverse geology, topography and climate. The headwaters of the Colorado and most of its tributaries originate in the mountains forming the eastern boundary of the area. Elevations range from > 10,000 ft above sea level in the mountains to < 4,500 ft at the Colorado-Utah border. Precipitation in the mountains can exceed 40 in annually, most of it as snow. In the western basins, precipitation frequently is < 20 in/yr. Most of the runoff then is a result of snow melting in the spring. Surface water is the principal source of water supplies in the area, and irrigation is the major water use. Groundwater supplies are mainly from wells completed in alluvium or fractured bedrock. Greatest yields occur in valley floor alluvium deposits. All coal mines in the basin but one are underground. Production from these mines during 1982 totaled almost 4 million tons. Surface water quality is best in the mountains. Dissolved solids concentrations in the Colorado River increase an average of 647 mg/L as it flows through the area. The causes of this increase are nearly equally divided between natural sources and irrigation activities in the sedimentary basins. The climate in these basins is semiarid, and the soils are not adequately leached. Concentrations of several major elements and trace elements in the groundwater can be large enough to limit water uses. Among those elements exceeding recommended or required standards for use are calcium, chromium, iron, manganese, and lead. (Lantz-PTT)
W89-09188

HYDROLOGY OF AREA 39, WESTERN REGION, INTERIOR COAL PROVINCE KANSAS AND MISSOURI,
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. Bevans, F. Skelton, J. F. Kenny, and J. V. Davis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 83-851, July 1984. 83p, 24 fig, 3 tab, 98 ref.

Descriptors: *Coal mining, *Hydrologic budget, *Environmental effects, *Kansas, *Missouri, *Geohydrology, Rainfall, Land use, Groundwater budget, Erosion, Sedimentation, Groundwater level, Water quality.

The nationwide need for hydrologic information characterizing conditions in mined and potentially mined areas has become critical with the enactment of the Surface Mining Control and Reclamation Act of 1977. The report for Area 39 in eastern Kansas and western Missouri consists of a brief text accompanied by a map, graph, table or other illustration portraying the general geographic, geologic, and hydrologic environment of the area. Area 39 has an area of about 10,500 sq mi and includes all or parts of 13 Kansas counties and 14 Missouri counties. Major streams draining the area are the Marais des Cygnes (Osage), South Grand, Little Osage, Blackwater, Blue, and Little Blue Rivers, which are tributaries of the Missouri River. Mean annual rainfall in Area 39 ranges from 34 inches in the west to > 40 inches in the east. Agriculture and forests are the predominant land uses. Streams, ponds, and reservoirs provide about 94% of the water used in the area. Groundwater supplies are limited except in the Missouri and Marais des Cygnes (Osage) River valleys where wells in unconsolidated deposits may yield from 100 to 2,000 gal/min, and in the southeast part of the area where wells in consolidated aquifers of Ordovician age yield up to 600 gal/min of good quality water. Strippable coal reserves are present in Pennsylvanian rocks throughout many parts of the area. Coal mining activity has increased sharply since the 1960's; this mining is subject to state and federal reclamation laws. Erosion, sedimentation, water quality degradation, decline in groundwater levels, and diversion of surface drainage are typical problems associated with surface coal mining. (Lantz-PTT)
W89-09189

HYDRAULIC ANALYSES OF WATER-SURFACE PROFILES IN THE VICINITY OF THE COAMO DAM AND HIGHWAY 52 BRIDGE, SOUTHERN PUERTO RICO: FLOOD ANALYSES AS RELATED TO THE FLOOD OF OCTOBER 7, 1985,
Geological Survey, San Juan, PR. Water Resources Div.
K. G. Johnson, F. Quinones, and R. Gonazlez.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4039, 1987. 26p, 14 fig, 2 tab, 7 ref.

Descriptors: *Flood profiles, *Puerto Rico, *Surface water, *Coamo Dam, *Hydraulic profiles, *Flooding, Streamflow, Flood discharge, Hydraulic models, Hydraulic structures, Bridges, Flow profiles.

The magnitude, frequency and extent of the flood of October 7, 1985 at the Rio Coamo in the vicinity of the Coamo Dam and Highway 52 bridge in southern Puerto Rico, were investigated. The observed flood profiles were used to calibrate a step-backwater model. The calibrated model was then used to investigate several alternative flow conditions in the vicinity of the bridge. The peak discharge of the flood at the Highway 52 bridge was 72,000 cu ft/sec. This peak discharge was determined from the peak computed at a reach in the vicinity of the Banos de Coamo, about 1.2 mi upstream from the bridge. The computed discharge at the Banos de Coamo of 66,000 cu ft/sec was adjusted to the dam and bridge location by multiplying it by the ratio of the drainage areas raised to the 0.83 power. The flood had a recurrence interval of about 100 yr, exceeding all previously known floods at the site. The flood overtopped the spillway and levee of the Coamo Dam just upstream of Highway 52. The flow over the spillway was 54,000 cu ft/sec. Flow over the levee was about 18,000 cu ft/sec. About 10,000 cu ft/sec of the flow over the levee returned to the main channel at the base of the embankment at the northeast approach to the bridge. The remaining 8,000 cu ft/sec flowed south through the underpass on Highway 153. The embankment and shoulder on the northern span of the bridge were eroded with the eventual collapse of the approach slab. (Author's abstract)
W89-09194

BIOLOGICAL, MORPHOLOGICAL, AND CHEMICAL CHARACTERISTICS OF WAILUKU RIVER, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09196

PROFILE OF SACRAMENTO RIVER, FREEPORT TO VERONA, CALIFORNIA, FLOOD OF FEBRUARY 1986,
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Blodgett, and J. B. Lucas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-82, 1988. 16p, 3 fig, 5 tab, 1 plate, 15 ref.

Descriptors: *Flood profiles, *Sacramento River, *Floods, *California, Flooding, Flood peak, Flood control, Surface water, Flood stage.

A major storm in February 1986 caused record flooding in the Sacramento River and other nearby basins in north-coastal and central California. As part of an effort to document this flood, the peak water surface profile of a 33 mi reach of the Sacramento River was surveyed between Freeport and Verona, California. Supplementary profiles in this reach include elevations of the approximate top of levee, flood plain, and the water surface on March 17, 1987. On the Sacramento River at Sacramento, the peak discharge of 117,000 cu ft/sec occurred February 19 and 20, 1986. The peak stage of 30.58 ft on February 19 is the highest on record, including the period prior to construction of large flood control dams in the Sacramento River basin beginning with Shasta Dam in 1942. The February 1986 flood profile of the Sacramento River between the mouth of the American River and the Sacramento Weir (located upstream from the American River) shows a reverse water surface slope with a corresponding drop of about 0.13 ft. On the Sacramento River at Verona, upstream from Sacramento, a peak stage of 39.11 ft occurred February 20 (peak discharge 92,900 cu ft/sec) due to runoff from upstream tributaries. The February 1986 peak stage is the highest of record for 1914-87 (no record for 1918-20, 1922-25). The previous peak stage of record at Verona, March 1, 1940, was 38.20 ft, with a discharge of 79,200 cu ft/sec. (Author's abstract)
W89-09199

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT, IN THE 1987 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
C. A. Griner, and P. W. Anttila.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-177, 1988. 84p, 5 fig, 1 tab, 30 ref.

Descriptors: *Data collections, *Data acquisition, *US Geological Survey, *Water resources data, *California, Water quality, Project planning, Research priorities, Information exchange, Water supply, Water demand, Hydrology, Selenium, Water reuse, Saline water intrusion.

The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. Several of the most relevant and visible studies being conducted by the California District deal with selenium toxicity in the western San Joaquin Valley; groundwater export from the Owens Valley, coupled with vegetation survivability studies; hydrodynamics variability in San Francisco Bay; reclaimed water use; seawater intrusion in the Santa Barbara area; and involvement in the water-quality standard/water-rights hearing for the San Francisco Bay/Delta. Thirty-nine project summaries are provided. Water Resources Division basic mission and program, California District organization and funding, and 1987 water conditions are also summarized. (Lantz-PTT)
W89-09206

LARGEST RIVERS IN THE UNITED STATES,
Geological Survey, Reston, VA. Water Resources Div.
J. C. Kammerer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 87-242, August 1987. 2p, 1 fig, 1 tab, 1 ref.

Descriptors: *Rivers, *Data collections, River systems, Flow velocity, Discharge, River basins.

The location and ranking of the 20 largest rivers in the United States is shown. Rivers are considered large on the basis of one or more of three characteristics: total length from source to mouth, area of basin (watershed) drained by the stream, and average rate of flow (discharge) at the mouth. The alphabetical list shows these characteristics of 32 rivers so as to include the 20 largest rivers in each of the three categories. Among the 32 rivers, only 17 are independent; that is, rivers that discharge directly into oceans, seas, gulfs or bays. The other 15 rivers are tributaries. The Mississippi is the largest U.S. river. (Lantz-PTT)
W89-09208

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME 2: GENERAL INFORMATION AND STATION LIST FOR THE ISLANDS OF OAHU, MOLOKAI, MAUI, AND HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
I. Matsuoka.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 81-1056, December 1983. 50p, 22 tab, 5 ref.

Descriptors: *Surface water, *Hawaii, *Hydrologic data collections, Oahu, Molokai, Maui, Statistical studies, Discharge frequency, Water quality, Sedimentation, Phytoplankton.

Explanations of the statistical summaries of available surface water discharge records and tabulations of surface water quality parameters at data collection sites on the islands of Oahu, Molokai, Maui and Hawaii are presented. A brief history of the stream gaging program of the Water Resources Division of the U.S. Geological Survey in Hawaii, a concise site description and information, explanations and sample tables, various monthly and annual discharges, lowest and highest mean discharges for each year for specified numbers of consecutive days, statistics for monthly and annual mean discharges, and tabulation and summary of surface water quality data are included. Water quality parameters include sediment and phytoplankton data. (See also W89-09218 and W82-05836) (Author's abstract)
W89-09217

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME 3: STATION LOCATION MAPS FOR THE ISLANDS OF OAHU, MOLOKAI, MAUI AND HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09218

FINITE-ELEMENT MODEL STUDY OF THE IMPACT OF THE PROPOSED I-326 CROSSING ON FLOOD STAGES OF THE CONGAREE RIVER NEAR COLUMBIA, SOUTH CAROLINA,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09219

WATER RESOURCES OF ROCKLAND BASIN, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
R. P. Williams, and H. W. Young.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-755, December 1982. 62p, 19 fig, 6 tab, 55 ref.

Descriptors: *Surface water, *Water resources data, *Groundwater, *Hydrologic budget, *Snake River, *Geohydrology, Idaho, River basins, Aquifers, Groundwater budget, Groundwater movement, Streamflow, Water yield, East Fork Rock Creek, Water management, Precipitation, Evapotranspiration, Irrigation, Agriculture.

Rockland basin comprises about 320 sq mi of the Snake River drainage in southeastern Idaho. Mountain ranges bordering the basin are composed predominantly of limestone and are complexly faulted. Major aquifers include Holocene alluvium, Quaternary-Tertiary volcanic rocks, and Tertiary sedimentary rocks. Groundwater occurs under water table conditions except where it is locally confined. Groundwater discharges to springs in the Deep Creek Mountains and maintains perennial streamflow. Near the mouth of Rock Creek, groundwater movement is northward toward the Snake River. Underflow is estimated to be 51,000 acre-ft/yr. Total water yield available to Rockland basin is estimated to be 5.0 in. (85,000 acre-ft) of the estimated 17.3 in. of annual precipitation. Evapotranspiration ranges from 9.9 to 17 in./yr, depending, in part, on altitude of the land surface. An estimated 12,000 acre-ft of surface water and 3,500 acre-ft of groundwater are used annually for irrigation. Less than 100 acre-ft of water is used for public supply, domestic, and stock supplies. East Fork Rock Creek supplies the most surface water for irrigation of agricultural lands. At the present (1980) state of groundwater development in Rockland basin, streams and aquifers are hydraulically connected. Pumping of groundwater in increased quantities from wells near streams will affect groundwater movement and may diminish streamflow. There are no long-term regional water table declines at present. Continued water level monitoring of selected wells may aid in documenting effects of future management practices on the groundwater system. (Author's abstract)
W89-09223

SURFACE WATER-QUALITY ASSESSMENT OF THE LOWER KANSAS RIVER BASIN, KANSAS AND NEBRASKA: PROJECT DESCRIPTION,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09235

MAPS OF RUNOFF IN THE NORTHEASTERN REGION AND THE SOUTHERN BLUE RIDGE PROVINCE OF THE UNITED STATES DURING SELECTED PERIODS IN 1983-85,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09236

WATER-QUALITY DATA FOR THE CLARK FORK AND SELECTED TRIBUTARIES FROM DEER LODGE TO MILLTOWN, MONTANA, MARCH 1985 THROUGH JUNE 1986,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09237

FLOODS OF MAY 17-18, 1985 AND OCTOBER 6-7, 1985 IN PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
F. Quinones, and K. G. Johnson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-123, 1987. 22p, 11 fig, 4 tab, 4 ref.

Descriptors: *Floods, *Puerto Rico, *Precipitation, Tropical regions, Flooding, Rio Grande de Manati, Rio Grande de Arecibo, Flood peak, Flood frequency, Flood damage, Costs.

Severe floods occurred in Puerto Rico twice in 1985. During May 15-19, 1985, as much as 25 in. of rainfall produced significant floods along north and north-central basins in the island. A nearly stationary tropical depression affected Puerto Rico during October 5-8, 1985, resulting in 24-hr precipitation totals of as much as 23 in. and severe floods along the south-central coastal areas. During the May 17-18, 1985 event, the areas most seriously affected by flooding were along the north coast. These included the lower reaches of the Rio Grande de Manati and the Rio Grande de Arecibo. Significant flooding also occurred at Utuado and Jayuya. The recurrence interval of most of the flood peaks was generally < 25 yr. The floods of October 6-7, 1985, affected mostly rural areas in southern Puerto Rico, but caused significant loss of life and widespread property damages. Landslides near Ponce, the collapse of a bridge at Rio Coamo, and the destruction of homes near Ponce resulted in about 170 fatalities and > 125 million dollars in damages. Flooding was also severe at Barceloneta on the north coast. Recurrence intervals $=$ or $>$ 100 yr were estimated for peak discharges at several index stations. (Author's abstract)
W89-09242

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS–FISCAL YEARS 1985 AND 1986,
Geological Survey, Lawrence, KS. Water Resources Div.
L. J. Combs.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-211, 1987. 108p, 11 fig, 6 tab, 47 ref.

Descriptors: *Water resources data, *Kansas, *Data acquisition, *Research priorities, Economic aspects, Project planning, Surface water, Groundwater, Bibliographics.

The principal mission of the U.S. Geological Survey, Water Resources Division, in Kansas is to investigate the occurrence, quantity, quality, distribution, and movement of surface and groundwater throughout the State. Primary activities include the systematic collection, analysis and interpretation of hydrologic data, evaluation of water demands, and water resources research. Hydrologic investigations are conducted through: (1) data collection programs, (2) statewide or regional investigations, (3) local or areal investigations, and (4) research. These projects are funded through cooperative agreements with state and local agencies, transfer of funds from other federal agencies, and direct federal funds. Forty-three water related projects were ongoing during fiscal years 1985 and 1986 in Kansas. This report describes for each project the problem that initiated the study, the objectives of the project, the approach designed to achieve the objectives, and significant milestones or publications that resulted during fiscal years 1985 and 1986. Information on more than 2,150 data collection stations in Kansas is presented in maps and tables. A list of 47 project reports published or released by the U.S. Geological Survey, its cooperators, or technical and scientific organizations during 1985 and 1986 is provided. (Author's abstract)
W89-09247

SURFACE-WATER-QUALITY ASSESSMENT OF THE YAKIMA RIVER BASIN, WASHINGTON: PROJECT DESCRIPTION,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-09248

DETERMINATION OF STREAM REAERATION COEFFICIENTS BY USE OF TRACERS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09249

WATER RESOURCES ACTIVITIES, GEORGIA DISTRICT, 1986,
Geological Survey, Doraville, GA. Water Resources Div.
C. A. Casteel, and M. D. Ballew.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-381, 1987. 59p, 8 fig, 2 tab, 257 ref.

Descriptors: *Georgia, *Water resources data, *Data acquisition, *Hydrologic data, Project planning, Research priorities, Interagency cooperation, Stream gaging, Groundwater level, Discharge measurement, Flow discharge.

The U.S. Geological Survey, through its Water Resources Division, investigates the occurrence, quantity, quality, distribution, and movement of the surface and underground water that composes the Nation's water resources. Much of the work is a cooperative effort in which planning and financial support are shared by state and local governments and other federal agencies. This report contains a brief description of the water-resources investigations in Georgia in which the Geological Survey participates, and a list of selected references. Water-resources data for the 1985 water

year for Georgia consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and groundwater levels. These data include discharge records for 108 gaging stations; water quality for 43 continuous stations, 109 periodic stations, and miscellaneous sites; peak stage and discharge only for 130 crest-stage partial-record stations and 44 miscellaneous sites; and water levels of 27 observation wells. Nineteen Georgia District projects are summarized. (Lantz-PTT)
W89-09252

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA--FISCAL YEARS 1986-87,
Geological Survey, Huron, SD. Water Resources Div.
E. M. Decker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-383, 1987. 61p, 7 fig, 4 tab.

Descriptors: *Water resources data, *South Dakota, *Hydrologic data, Water quality, Aquifers, Groundwater budget, Model studies, Surface water.

In South Dakota, the first collection of streamflow data by the U.S. Geological Survey (USGS) was in 1903. Despite its early beginning, it was not until October 16, 1944, that the Bismarck District, comprising the states of North Dakota and South Dakota, was created to assess the water resources of the two states. The next major increase in collection of surface water records occurred during the mid-1940's as a result of the Pick-Sloan Plan for Missouri Basin development. Since 1944, about 98 water resources studies have been made in South Dakota. These range from reconnaissance-type studies of counties and Indian reservations to research on small basin runoff and toxic wastes, the quality of water in lakes, the use of remote sensing for defining aquifers, and studies using digital models to describe the groundwater regimen and surface water hydraulics such as those currently underway in the James River basin and the Big Sioux River basin. During the past 20 years, 140 formal reports describing the studies and results of investigations have been prepared to inform the public and the scientific community. The location of surface water stations and observation wells in bedrock are tabulated. Brief (1 page) descriptions of current water resources projects in South Dakota include information on the location, purpose, period of performance, cooperating agencies, project leader, and completed reports. (Lantz-PTT)
W89-09253

FLOOD-FLOW CHARACTERISTICS OF NANCY CREEK AT GEORGIA HIGHWAY 400 EXTENSION NEAR ATLANTA, GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
M. Price, and G. W. Hess.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-386, 1987. 25p, 10 fig, 3 tab, 11 ref.

Descriptors: *Highway effects, *Backwater effect, *Flood flow, *Nancy Creek, *Georgia, Flood frequency, Flood discharge, Streamflow, Bridges, Flood peak.

The Highway Division, Georgia Department of Transportation, plans the extension of Georgia Highway 400 from Interstate 285 southward to Interstate 85. As part of this extension, the Highway Division plans construction of a bridge crossing Nancy Creek near Atlanta, Georgia. The U.S. Geological Survey, in cooperation with the Highway Division, determined the flood flow characteristics of Nancy Creek near the bridge crossing. The flood frequency, elevation discharge relation, flood profiles, floodway, and flood flow effects were determined. The maximum backwater effect for the proposed bridge and relocated channel was 0.2 ft for the 100-yr flood. The relocated channel will drastically shorten flow length near the proposed State Highway 400 extension and reduce the 100-yr flood elevation between one and two ft from existing conditions between the proposed site and Windsor Parkway. (Author's abstract)
W89-09255

FORMATION AND FAILURE OF NATURAL DAMS,
Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 8D.
W89-09257

INDEX OF SURFACE-WATER STATIONS IN TEXAS, JANUARY 1987.
Geological Survey, Austin, TX. Water Resources Div.
E. R. Carrillo, H. D. Buckner, and J. Rawson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 87-468, 1987. 16p, 1 tab, 2 plates.

Descriptors: *Gaging stations, *Stream gages, *Surface water, *Texas, *Data acquisition, Classification, Indexing, Reservoirs, Networks.

As of January 1, 1987, the surface water data collection network in Texas included 376 continuous streamflow, 76 continuous or daily reservoir content, 34 gage height, 16 crest stage partial record, 8 periodic discharge through range, 33 flood hydrograph partial record, 9 flood profile partial record, 36 low flow partial record, 46 daily chemical quality, 19 continuous recording water quality, 84 periodic biological, 17 lake surveys, 162 periodic organic and/or nutrient, 3 periodic insecticide, 42 periodic pesticide, 19 automatic sampler, 141 periodic minor elements, 130 periodic chemical quality, 78 periodic physical organic, 22 continuous recording temperature, and 30 national stream quality accounting network stations. The index shows the station number and name, latitude and longitude, type of data collected, and the office principally responsible for the data collection. An 8-digit permanent numerical designation for gaging stations has been adopted on a nationwide basis; stations are numbered and listed in downstream order. In the downstream direction along the main stem, all stations on a tributary entering above a mainstem station are listed before that station. A tributary entering between two main stem stations is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is an immediate tributary, each indention in the listing of gaging stations represents one rank. This downstream order and system of indention shows which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated. (Lantz-PTT)
W89-09265

FLOODFLOW CHARACTERISTICS AT PROPOSED BRIDGE SITE FOR STATE HIGHWAY 99, KANSAS RIVER AT WAMEGO, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
K. D. Medina.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-470, 1987. 13p, 8 fig, 7 ref.

Descriptors: *Highway effects, *Kansas, *Flood flow, *Kansas River, *Bridge construction, Levees, Streamflow, Flood control, Flood discharge, Hydraulic structures, Culverts.

The Kansas Department of Transportation has proposed replacing a bridge over the Kansas River on State Highway 99, at Wamego, Kansas. The ability of the main channel along with the existing agricultural levee to contain the flow of the Kansas River, the effect of overflow structures under the highway south of the bridge, and the effect of an island upstream from the proposed bridge are discussed. The design of the proposed new bridge is adequate for passage of a 100-yr flood of 155,000 cu ft/sec; however, the existing levee along the right bank of the river upstream of the proposed bridge will not confine the flow to the main channel because parts of the levee have been broken or removed. The present overflow structures would allow a discharge of 26,000 cu ft/sec to occur in the bypass reach with a maximum depth of flow over the highway of 1.3 ft. If the structures were removed but the highway grade maintained, the discharge would increase to about 30,000 cu ft/sec with a depth of flow over the highway of 1.5 ft. If the overflow structures were removed and the elevated sections of the highway grade leveled, the discharge would increase to about 31,500 cu ft/sec, with a maximum depth of flow over the highway of 1.3 ft. The velocity of flow through four 30-in diameter concrete culverts located at overflow structure sites would be 8.6 ft/sec. Foreseeable changes in the island upstream from the proposed bridge would not interfere with the flow capacity of the new bridge. (Author's abstract)
W89-09267

2F. Groundwater

NUMERICAL SIMULATION OF GROUNDWATER CONTAMINANT TRANSPORT ON A SUPERCOMPUTER WITH INJECTION-PUMPING NETWORKS USING THE MODIFIED MOC AND MFE METHOD,
Rice Univ., Houston, TX. Graduate School.
For primary bibliographic entry see Field 5B.
W89-08240

MULTIPHASE IMMISCIBLE FLOW THROUGH POROUS MEDIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Graduate School.
For primary bibliographic entry see Field 5B.
W89-08245

THREE-PHASE FLOW ANALYSIS OF OIL SPILLS IN PARTIALLY WATER-SATURATED SOILS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08246

STOCHASTIC ANALYSIS OF POLLUTANT MOVEMENT IN GROUNDWATER,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08250

TWO-DIMENSIONAL FINITE-ELEMENT PROGRAMS FOR WATER FLOW AND WATER QUALITY IN MULTI-AQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
S. M. A. El Didy.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8623847. Ph.D. Dissertation, 1986. 132p, 27 fig, 6 tab, 67 ref, 2 append.

Descriptors: *Model studies, *Groundwater movement, *Path of pollutants, *Finite element method, *Water quality, *Coal gasification, Numerical analysis, Mathematical models, Computer models, Mass transfer, Computer programs, Aquifer systems.

Two finite element models are presented for water flow and quality in multiple aquifer systems, with application for general problems and those associated with burned cavities at coal gasification sites. Both models are based on the Galerkin weighted-residual method and eight-noded isoparametric elements are used. Spatial numerical integration is performed using Gaussian quadrature. Depending on the value of the weighting coefficient, the solution can be made strictly implicit, Crank-Nicolson, or an explicit scheme. The models are written in FORTRAN V on the CDC CYBER 175. For the

flow model, the basic partial differential equation for a single aquifer is modified to take into account its interaction with the adjacent aquifers of the system. For the quality model, the mass transport equation of a single aquifer is modified to take into account interactions between the adjacent aquifers of the system. For solute transport, the program considers convection, adsorption-desorption, decay, and dispersion mechanisms. (Cremmins-AEPCO)
W89-08257

HYDROLOGICAL INVERSE PROBLEM: RECONSIDERATION AND APPLICATION TO THE MICROCOMPUTER,
Florida State Univ., Tallahassee. Dept. of Geology.
M. Cushman-Roisin.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8619512. Ph.D. Dissertation, 1986. 92p, 12 fig, 7 tab, 82 ref, append.

Descriptors: *Model studies, *Hydrologic models, *Groundwater movement, *Mathematical models, *Aquifer characteristics, Groundwater runoff, Transmissivity, Groundwater storage, Computer models, Computer programs, Sensitivity analysis.

The hydrological inverse problem was solved on an IBM microcomputer using transmissivity values in the form required for standard computer models. A transmissivity distribution and slightly modified head and flux fields were determined by minimizing an objective that is reduced to retain the most important components. Equations resulting from the objective function were solved iteratively by successive overrelaxation. Transmissivity, head, and flux distributions were chosen to meet the steady-state hydrological equation. A second transmissivity distribution was obtained from the head and flux values at grid points using the inverse method. True and recovered transmissivities were then compared with percentage of recovery greater than 90%. Variations in initial guesses for transmissivity were neglibile. Comparison of the results of the method with transmissivity values for a sand and gravel aquifer showed good agreement. Sensitivity analysis revealed only a reasonable amount of amplification of noise error. (Cremmins-AEPCO)
W89-08261

POLITICAL ECONOMY OF NATURAL RESOURCES: WATER SCARCITY IN THE HIGH PLAINS REGION OF THE U.S.,
Columbia Univ., New York. Graduate School of Arts and Sciences.
For primary bibliographic entry see Field 4B.
W89-08262

SUMMARY OF WATER DATA FOR THE JANZEN RECHARGE INVESTIGATION, SCOTT COUNTY, KANSAS, 1980-86,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08305

ANALYSES OF WATER RESOURCES OF THE BIG SIOUX AQUIFER, MOODY COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
D. S. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 87-4057, 1988. 38p, 13 fig, 11 tab, 19 ref.

Descriptors: *Groundwater movement, *Hydrologic data, *Water resources, *Groundwater resources, *South Dakota, Aquifers, Groundwater, Aquifer characteristics, Model studies, Water use, Water table, Drawdown, Big Sioux aquifer.

The Big Sioux aquifer in Moody County is a 55 sq mi, water table aquifer hydraulically connected to the Big Sioux River. The average thickness is 22 ft and the maximum thickness is 54 ft. A digital model was developed to simulate groundwater flow in the Big Sioux aquifer in Moody County. The model was calibrated for steady-state conditions using average hydrologic conditions from 1970 through 1979. Steady-state simulated water levels from 11 wells averaged 0.4 ft higher than measured water levels. The model was calibrated for transient conditions using 1983 water levels. The average monthly difference in 27 observation wells between simulated and measured water levels was 2.63 ft. Sensitivity analyses showed that recharge rate and evapotranspiration extinction depth had the largest effect on simulated water levels. A 4-inch/year increase in the recharge rate caused simulated water levels to rise 1.7 ft. A 2.5-ft increase in the extinction depth caused simulated water levels to decline 0.8 ft. The calibrated model was used to simulate the effects of three hypothetical hydrologic situations. The first situation simulated the transient effects of 1983 pumpage under severe drought conditions. The second hypothetical situation simulated the steady-state effects of increased pumping at a rate of 5,200 acre-ft/year under average hydrologic conditions. The third hypothetical situation simulated the transient effects of pumping 5,200 acre-ft/year under severe drought conditions. Stored water was not depleted in any nodes after these simulations. (USGS)
W89-08306

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1988,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08307

WATER QUALITY DATA FROM THE OBSERVATION WELL NETWORK IN ILLINOIS, 1985-87,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08308

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1988,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08309

HYDROGEOLOGY AND WATER SUPPLY POTENTIAL OF THE WATER TABLE AQUIFER ON DAUPHIN ISLAND, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
R. E. Kidd.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 87-4283, 1988. 49p, 21 fig, 6 tab, 19 ref.

Descriptors: *Model studies, *Saline water intrusion, *Barrier islands, *Alabama, *Water supply, Hydrogeologic units, Water table aquifers, Dauphin Island, Hydraulic conductivity, Water quality, Groundwater movement.

The water table aquifer on Dauphin Island, Alabama, consists of a thin veneer of Holocene sand and an underlying Pleistocene unit locally known as the Gulfport Formation. The aquifer is from 28 to 35 ft thick with a thick marine clay at its base. Water in the aquifer generally is low in chloride content except near the coast. Excessively high iron concentrations in groundwater were found locally. A two-dimensional finite-difference groundwater flow model of the water table aquifer on Dauphin Island was used in the steady-state mode to evaluate the flow system under steady-state conditions. Model input data were obtained primarily from 40 test wells, 2 aquifer tests, continuous recording of groundwater levels, and rainfall. The model was calibrated to the low water-table conditions of July 1985 and high water table conditions of April 1985. The model was also used to simulate pumpage from the aquifer under transient conditions with no rainfall. Patterns of computed head changes compared favorably to the natural recession of water levels for the periods of April to May 1985 and May to June 1985. Simulation of groundwater withdrawals in the transient model showed the feasibility of producing 0.6 million gallons/day from eight wells that tap the water table aquifer without inducing lateral seawater encroachment. (USGS)
W89-08310

DESCRIPTION AND EVALUATION OF THE EFFECTS OF URBAN AND AGRICULTURAL DEVELOPMENT OF THE SURFICIAL AQUIFER SYSTEM, PALM BEACH COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08312

PRELIMINARY EVALUATION OF THE GROUNDWATER RESOURCES OF BAINBRIDGE ISLAND, KITSAP COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion, T. D. Olsen, and K. L. Payne.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 87-2437, 1988. 82p, 21 fig, 10 tab, 23 ref.

Descriptors: *Groundwater resources, *Saline water intrusion, *Bainbridge Island, *Washington, *Geohydrology, Water resources data, Geohydrologic units, Water quality, Kitsap County.

Bainbridge Island is underlain by as much as 1,600 ft of unconsolidated deposits of Quaternary age. Most domestic groundwater supplies are taken from two relatively coarse-grained geohydrologic units composed largely of glacial sand and gravel. Neither of these two aquifers, generally separated by a finer-grained semi-confining unit, is laterally continuous across the entire island. Groundwater withdrawal on the island in 1984 was estimated to be 1,235 acre-ft. Of this amount, 60% (740 acre-ft) was withdrawn for public supply purposes, 37% (460 acre-ft) for domestic purposes, and about 3% (35 acre-ft) for industrial purposes. The chemical quality of groundwater on Bainbridge Island generally is suitable for most uses and most samples were within State drinking water standards. However, 3 of 48 samples exceeded the criterion for iron and 19 exceeded the criterion for manganese. Chloride concentrations were small in April and September 1985, and the concentrations changed little seasonally. These observations indicate that seawater intrusion currently is not a problem on the island. The data now available are adequate to permit an assessment of the groundwater resources of the island, but only in a qualitative manner and only for the uppermost part of the thick unconsolidated deposits. The data are not adequate, however, to permit an assessment of the effects of additional groundwater development. (USGS)
W89-08313

GEOHYDROLOGY OF THE FLATHEAD INDIAN RESERVATION, NORTHWESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
S. E. Slagle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigation Report 88-4142, September 1988. 152p, 18 fig, 2 plates, 17 tab, 61 ref.

Descriptors: *Groundwater availability, *Geohydrology, *Glacial aquifers, *Water quality, *Montana, Groundwater, Data collections, Hydrologic data, Water yield, Flathead Indiana Reservation.

The geohydrology of the Flathead Indian Reservation was studied to provide information needed to formulate groundwater development plans. Bedrock in the area consists predominantly of slightly metamorphosed carbonate and fine-grained clasitc rocks of the Precambrian Belt Supergroup. Valley-fill deposits consist of alluvium of Holocene age; glacial and glaciolacustrine boulders, cobbles, gravel, sand, silt, and clay of Pleistocene age; and siltstone, fine-grained sandstone, and coal of probable Tertiary age. Most wells in the reservation are completed in valley-fill aquifers--for which well discharge ranges from 0.5 to 1,600 gal/minute and transmissivity ranges from 3.2 to 45,600 sq ft/day. Groundwater flow follows the trend of the respective valleys. Water level in valley-fill aquifers fluctuates seasonally in response to recharge from streams and irrigation canals and discharge from wells. Recharge to valley-fill aquifers occurs by direct infiltration of snowmelt and rainfall, leakage from streams and irrigation canals, subsurface inflow, and irrigation return flow. Discharge from the valley-fill aquifers occurs through evaporation, transpiration by plants, withdrawals from wells, leakage to rivers and streams, and subsurface outflow. Water in bedrock is available from fracture zones of secondary permeability; discharge from wells completed in bedrock ranges from 2.5 to 40 gal/min. Water from wells and springs is calcium bicarbonate or sodium bicarbonate type and contained dissolved-solids concentrations of 42 to 1,100 mg/L. All dissolved constituents in most samples were within Federal drinking water standards. (USGS)
W89-08315

GEOLOGIC AND GEOHYDROLOGIC RECONNAISSANCE OF STATEN ISLAND, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
J. Soren.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 87-4048, 1988. 22p, 8 fig, 1 tab, 16 ref.

Descriptors: *Geohydrology, *New York, *Staten Island, *Water resources data, Geologic formations, Subsurface mapping, Glacial drift, Groundwater resources, Hydrologic data, Streamflow, Areal hydrogeology, Water table.

The public water supply for about 350,000 people on Staten Island (Richmond County)--a mainly suburban 60-sq mi borough of the City of New York is provided by the City from reservoirs in upstate New York. Since 1962, many individuals and businesses have used groundwater for supplemental supply as a result of the City's ban on the use of public supply water for irrigation, swimming pools, and automobile washing during protracted droughts that depleted the reservoirs. Hundreds of wells were installed on the island during droughts of 1962-66 and 1983-85. Bedrock of Late Proterozoic to Jurassic age and unconsolidated deposits of the Upper Cretaceous and late Pleistocene age contain groundwater that is generally suitable for the city prohibited purposes. The groundwater of the island receives sufficient recharge to meet the current demands and could sustain considerably greater withdrawals. (USGS)
W89-08317

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 1: HYDROGEOLOGY AND WATER QUALITY,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08318

ALTERNATIVE SOURCES OF LARGE SEASONAL GROUNDWATER SUPPLIES IN THE HEADWATER OF THE SUSQUEHANNA RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
A. D. Randall, D. S. Snavely, T. J. Holocek, and R. M. Waller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 85-4127, 1988. 121p, 34 fig, 43 ref.

Descriptors: *Surface-groundwater relations, *New York, *Susquehanna River, *Alluvial aquifers, *Glacial aquifers, Influent streams, Groundwater recharge, Seasonal depletion, Computer models, Seepage, Model studies.

The northern divide of the Susquehanna River basin crosses 29 broad valleys that contain thick glacial deposits but are drained only by small headwater streams. Much groundwater could be withdrawn from sand and gravel deposits in these valleys with little immediate effect on streamflow. A digital model of the headwater reach of one typical valley suggests that pumping 10.8 million gal/day for 2 months every summer would lower the water table as much as 33 ft, cause the upper 1,900 ft of the stream draining the valley to go dry, and reduce streamflow downvalley by 1.2 million gal/day by the time pumping ceased. Saturated thickness of surficial sand and gravel exceeds 40 ft in about half the headwater valley reaches; the valley floor areas range from 0.2 to 9 sq mi. Seepage losses from small streams that carry runoff from adjacent till-covered uplands are a major source of recharge to aquifers in these valleys under natural conditions and would increase if the water table were lowered by seasonal withdrawals. Some aquifers beneath extensive clay layers in these and other valleys of the Susquehanna River basin may be partially independent of streams but not easily evaluated. (USGS)
W89-08319

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK. PART 2. SIMULATION OF GROUNDWATER FLOW,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08320

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 3: SIMULATION OF SOLUTE TRANSPORT,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08321

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--ADIRONDACK SHEET,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08323

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--LOWER HUDSON SHEET,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08324

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--NIAGARA SHEET,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08326

GROUNDWATER AVAILABILITY IN THE CENTRAL PART OF LAKE ONTARIO BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08327

HYDROLOGIC AND MINING DATA FROM AN AREA OF UNDERGROUND COAL MINING IN GARRETT COUNTY, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
S. N. Hiortdahl.
Available from Maryland Geological Survey 2300 St. Paul Street, Baltimore, MD 21218. Maryland Geological Survey Report of Investigations 41-A, 1988. 81p, 16 fig, 2 tab, 7 ref, append.

Descriptors: *Acid mine drainage, *Seepage loss, *Underground coal mining, *Groundwater level, *Maryland, Streamflow, Mine-dewatering, Garrett County.

This report is the second in a series of reports about the hydrologic conditions in an area of underground coal mining in southwestern Garrett County, Maryland. Hydrologic and mining data collected during October 1981 to September 1984 are presented, and changes in mining activity and hydrologic conditions during the first and second study phases are briefly described. Three contiguous mine-permit areas were worked with the room-and-pillar method. Extraction of coal was about 50% complete by the end of 1984. The cumulative area undermined increased from about 650 acres in July 1981 to about 1,650 acres by July 1984. Total annual mine pumpage increased from 410 to 660 million gal/year during this period. Long-term declines in water levels, ranging from tens to hundreds of ft, occurred in the observation wells at one undermined well-cluster site. A long-term water level decline, averaging about 30 ft/year, occurred in two wells which are open to the confined zone below the mines. Discharges of treated acid mine drainage significantly increased streamflow and specific conductance in the South Fork Sand Run (drainage area 1.6 sq mi), while having less of an effect on Laurel Run (drainage area 8.2 sq mi). Several main-channel segments of Laurel Run lost flow to the local groundwater system. Periodic streamflow-seepage measurements indicate that the location of the stream channel seepage losses vary with time. (USGS)
W89-08333

FRESHWATER SUPPLY POTENTIAL OF THE ATLANTIC INTRACOASTAL WATERWAY NEAR MYRTLE BEACH, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
W. J. Carswell, C. L. Sanders, and D. M. Dale.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 88-4066, 1988. 45p, 22 fig, 5 tab, 16 ref.

Descriptors: *Surface water availability, *Hydrologic data, *Saline water intrusion, Minimum flow, Coastal waters, Inland waterways, Canals, Model studies, Water resources development, Frequency analysis.

A study was conducted to determine the low-flow frequency of freshwater flow in the Atlantic Intracoastal Waterway (AICW) near Myrtle Beach, South Carolina and to determine the effects of proposed freshwater withdrawals of 45 cu ft/sec at the location of the saltwater-freshwater interface. Discharges simulated in the AICW for 1982-86 using BRANCH one-dimensional flow model were used to establish a relation of 7-day average flows in the AICW to summed 7-day average flows of four tributary streams. This relation was used with the tributary records for 1954-86 climatic years to generate 7-day minimum flows of the AICW, which were then used to develop a low-flow frequency relation. The relation indicated that the 7-day, 10-year flow of the Atlantic Intracoastal Waterway is 192 ct ft/s. A relation of the mile position of the saltwater-freshwater interface to recorded specific conductances at Vereen's Marina was established. The 1982-85 period of record of specific conductance was used to simulate interface positions which were then used to establish a relation

of 7-day average interface position to 7-day average discharge of the AICW. This relation indicated that the 7-day average interface position would be at mile 355.5 for the 7Q10 and at mile 356.2 if 45 cu ft were withdrawn during the 7Q10. The analysis indicates that the AICW can provide a reliable supply of freshwater at the proposed withdrawal location at mi 363.3 in the vicinity of Myrtle Beach, even during the 7Q10 low-flow conditions. (USGS)
W89-08335

FIELD STUDY OF EPHEMERAL STREAM INFILTRATION AND RECHARGE,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115554/AS, price codes: A09 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 228, January 1988. 187p, 24 fig, 12 tab, 31 ref, 6 append. USGS contract 14-08-0001-G1241. USGS state project 1423658. USGS project G1241-06.

Descriptors: *Surface-groundwater relations, *Groundwater recharge, *Aquifers, *Streamflow, *Infiltration, *New Mexico, Rio Puerco, Rio Salado, Monitoring, Seepage, Monitoring wells, Neutron logging wells.

Two ephemeral streams north of Socorro, NM, the Rio Puerco and Rio Salado, have been instrumented for the purpose of analyzing groundwater recharge due to channel seepage. Monitor wells and neutron logging wells provided information necessary to characterize the nature of stream aquifer interaction. Groundwater recharge was computed using concolution and other techniques. The Rio Puerco has relatively well-defined, straight channel with a small width-depth ratio and flows in response to both summer and winter precipitation, as well as spring runoff. The stream carries a large suspended sediment load which results in fine-textured sediments on the channel bottom. Although the water table is only about 1m below the channel, the stream and aquifer are not fully hydraulically connected at all times, owing to the development of a low-permeable clogging layer on the channel bottom. The Rio Salado is an ephemeral stream which has a very large width-depth ratio and a braided channel filled mostly with permeable sand and gravel. The Rio Salado flows mostly in the summer in response to thunderstorms. Prior to runoff the depth to groundwater below the channel is about 1m at the upper site and 9m at the lower site. Monitoring the water table elevations and moisture content indicates that during runoff the stream and aquifer are fully hydraulically connected at the upper site but not at the lower site. (Stephens-NM Inst. Mining and Tech.)
W89-08341

USER'S GUIDE FOR RIV2 - A PACKAGE FOR ROUTING AND ACCOUNTING OF RIVER DISCHARGE FOR A MODULAR, THREE-DIMENSIONAL, FINITE-DIFFERENCE, GROUNDWATER FLOW MODEL,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08354

WELL CONSTRUCTION, LITHOLOGY, AND GEOPHYSICAL LOGS FOR BOREHOLES IN BEAR CREEK VALLEY NEAR OAK RIDGE, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
Z. C. Bailey, and D. B. Withington.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4068, December 1988. 21p, 9 fig, 7 pl, 2 tab, 5 ref.

Descriptors: *Tennessee, *Groundwater, *Geohydrology, *Borehole geophysics, *Lithologic logs, Boreholes, Geologic formations, Geologic fractures, Grouting, Acoustic televiewer, Bear Creek Valley, Oak Ridge.

Twenty-four wells were constructed at nine sites at Bear Creek Valley to provide geologic and hydrologic information. Lithologic samples and suits of geophysical logs were obtained from the deepest boreholes at six of the sites. Two of these boreholes at the base of Chestnut Ridge were completed in the Maynardville Limestone and two were completed in the Nolichucky Shale. Two boreholes along Pine Ridge were completed in the Rome Formation. Zones of similar lithology within a borehole were delineated from rock cutting refined by examination of geophysical logs. The contact between the Maynardville Limestone and Nolichucky Shale was identified in two of the boreholes. Fractures and cavities were readily identifiable on the acoustic-televiewer and caliper logs. Distinct water-bearing intervals were also identified from the temperature, fluid resistance, and resistivity logs. Depths at which the drilling encounterd a thrust were identified in two boreholes in the Rome Formation from both rock cutting and geophysical logs. (USGS)
W89-08357

RECHARGE TO THE EAGLE VALLEY GROUNDWATER BASIN BY AUGMENTED STREAMFLOW IN VICEE CANYON, WESTERN NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-08361

GEOSTATISTICAL INTERPOLATION OF HYDROSTRATIGRAPHY AT GROUNDWATER CONTAMINATION SITES,
California Univ., Santa Cruz. Dept. of Earth Sciences.
J. S. Dreiss, and N. M. Johnson.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-143507/AS, price codes: A03 in paper copy, A01 in microfiche. Final Report, December 1988. 29p, 16 fig, 4 tab, 34 ref. USGS contract 14-08-001-G1311.

Descriptors: *Geostatistics, *Hydrostratigraphy, *Groundwater pollution, *Risks, *Geohydrologic boundaries, Statistical methods, Kriging indicators, Probabilities, Variograms, Boreholes, Permeability, Sediment deposition, California, Santa Clara Valley.

Much recent work in stochastic groundwater hydrology has focused on the spatial variability of hydraulic properties within geologic units. Few studies have attempted to incorporate uncertainties in the location of the boundaries of geologic units. This study illustrates the use of indicator geostatistics for interpreting complex alluvial stratigraphy from qualitative borehole logs. Locations of relatively high and low permeability regions are described by inferring relative permeability from borehole descriptions and assigning binary indicator values of either 1 or 0 to intervals in the borehole logs. The resulting indicator data can then be used to compute experimental variograms and construct three-dimensional variogram models. The approach is applied to a groundwater contamination site in Santa Clara Valley, CA. Computed indicator variograms are consistent with known stratigraphic features. They describe details in the spatial structure of the deposits that reflect differing deposition environments. Kriged indicator values represent probabilities that sediments at a location fall into one of the two indicator categories. The location of the 0.5 indicator contour is approximately the aquifer-aquitard boundary that might be constructed in a geologic cross-section. Indicator kriging consistently weights all the available data on the basis of a three-dimensional, anisotropic variogram model and provides an estimate of uncertainty in the hydrostratigraphic correlation. (USGS)
W89-08370

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA, 1981-87,
Geological Survey, Denver, CO. Water Resources Div.
J. H. Robison, D. M. Stephens, R. R. Luckey, and D. A. Baldwin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 88-468, (1988). 164p, 3 fig, 2 tab, 26 ref.

Descriptors: *Water level, *Water level fluctuations, Radioactive waste, *Yucca Mountain.

This report contains data on groundwater levels beneath Yucca Mountain and adjacent areas, Nye County, Nevada. In addition to new data collected since 1983, the report contains data that has been updated from previous reports, including added explanations of the data. The data was collected in cooperation with the U.S. Department of Energy to help that agency evaluate the suitability of the area of storing high-level nuclear waste. The water table in the Yucca Mountain area occurs in ash-flow and air-fall tuff of Tertiary age. West of the crest of Yucca Mountain, water level altitudes are about 775 m above sea level. Along the eastern edge and southern end of Yucca Mountain, the potentiometric surface generally is nearly flat, ranging from about 730 to 728 m above sea level. (USGS)
W89-08378

PROGRESS REPORT ON THE GROUNDWATER, SURFACE WATER, AND QUALITY OF WATER MONITORING PROGRAM, BLACK MESA AREA, NORTHEASTERN ARIZONA, 1987-88,
Geological Survey, Flagstaff, AZ. Water Resources Div.
R. J. Hart, and J. P. Sottilare.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-467, August 1988. 39p, 6 fig, 9 tab, 8 ref.

Descriptors: *Groundwater, *Water level, *Water quality, Northeastern Arizona, Black Mesa, Navajo Indiana Reservation, Hopi Reservation, N aquifer.

The Black Mesa monitoring program is designed to monitor long-term effects on the water resources of the area resulting from withdrawals of groundwater from the N aquifer by the strip-mining operation of Peabody Coal Company. Withdrawals by Peabody Coal Company increased from 95 acre-ft in 1968 to 3,832 acre-ft in 1987. The N aquifer is an important source of water in the 5,400 sq mi Black Mesa area on the Navajo and Hopi Indian Reservations. Water levels in the confined area of the Aquifer declined as much as 95 ft near Keams Canyon from 1965 to 1988. Part of the decline measured in municipal wells may be due to local pumping. During 1965-88, water levels in wells that tap the unconfined area of the aquifer have not declined significantly and have risen in many areas. Chemical analyses indicate no significant changes in the quality of water in wells that tap the N aquifer or from springs that discharge from several stratigraphic units, including N aquifer, since pumping began at the mine. (USGS)
W89-08380

GEOHYDROLOGIC DATA FROM TEST-HOLE (USW UZ-7) YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,
Geological Survey, Mercury, NV. Water Resources Div.
J. Kume, and D. P. Hammermeister.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-465 (1988). 9 fig, 15 tab, 15 ref.

Descriptors: *Water content, *Water potential, *Tuff, Bulk density, Grain density, Porosity, Tritium.

This report contains a description of the methods used in drilling and coring of the test-hole USW UZ-7, a description of the methods used in collect-

ing, handling, and testing of test-hole samples; Lithologic information from the test hole; and water-content, water-potential, bulk-density, grain-density, porosity, and tritium data for the test hole. Test-hole USW UZ-7 was drilled and cored to a total depth of 62.94 m. The drilling was done using air as a drilling fluid to minimize disturbance to the water content of cores, drill-bit cuttings, and borehole wall-rock. Beginning at the land surface, the unsaturated-zone rock that was penetrated consisted of alluvium; welded and partially to nonwelded ash-flow tuff; bedded and reworked ash-fall tuff; nonwelded ash-flow tuff; and welded ash-flow tuff. Values of gravimetric water content and water potential of alluvium were intermediate between the extreme values in welded and nonwelded units of tuff. Gravimetric water content was largest in bedded and nonwelded ash-fall tuffs and was smallest in welded ash-flow tuff. Values of water potential were more negative in densely welded ash-flow tuffs and were less negative in bedded and nonwelded ash-fall tuffs. Bulk density was largest in densely welded ash-flow tuffs and smallest in nonwelded and bedded ash-fall tuffs. Grain density was uniform but was slightly larger in nonwelded and bedded ash-fall tuffs than in welded ash-flow tuffs. Porosity trends were opposite to bulk-density trends. Tritium content in alluvium was smallest near the alluvium-bedrock contact, markedly increased in the middle of the deposit, and decreased in the near-surface zone of the deposit. (Author's abstract)
W89-08381

CHEMICAL AND HYDROLOGIC DATA FOR SELECTED THERMAL-WATER WELLS AND NONTHERMAL SPRINGS IN THE BOISE AREA, SOUTHWESTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
H. W. Young, D. J. Parliman, and R. H. Mariner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-471, (1988). 42p, 5 fig, 3 tab.

Descriptors: *Water quality, *Hydrologic data, *Thermal water, Springs, Wells, Boise, Idaho.

This report presents data collected during January to July 1988 from 37 thermal water wells and 3 nonthermal springs in the Boise area, southwestern Idaho. Included are well and spring locations; well-construction, water-level, and water-use information; hydrographs of water levels in 3 wells; chemical and isotopic analyses of water from 18 thermal-water wells and 3 nonthermal springs; and drillers' logs from 23 wells. The purpose of the report is to make these data conveniently available to the public. (USGS)
W89-08383

SUBSURFACE OF STORAGE OF LIQUIDS IN THE FLORIDIAN AQUIFER SYSTEM IN SOUTH FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-08385

COMPILATION OF GROUNDWATER LEVEL MEASUREMENTS OBTAINED BY THE UNITED STATES GEOLOGICAL SURVEY IN PUERTO RICO, 1958-1985,
Geological Survey, San Juan, PR. Water Resources Div.
S. Torres-Gonzalez.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-701, 1988. 177p, 47 fig, 2 tab, 5 ref.

Descriptors: *Groundwater, *Water level, *Piezometric head, *Aquifers, Identifiers, Data base, Digital.

A digital compilation of the groundwater levels in Puerto Rico was prepared as part of the Caribbean Islands Regional Aquifers System Analysis program. Of special interest are the groundwater levels measurements obtained on a routine basis at wells located in the different aquifer regions or aquifer zones. Data from 181 observation wells were entered in the computer data base. The data base includes the following: name, latitude and longitude coordinates, owner, diameter, depth, station identification, local number, aquifer area or region, period of record, construction date, earliest groundwater level reported, and groundwater level fluctuations for various time periods between 1958 and 1985. Data showing conditions under which groundwater level measurements may have been affected by (1) pumping of the well, (2) by a nearby pumping well (3) a specific method by which the groundwater level was determined, (4) whether the well was recently pumped, and (5) when recorded, the lowest water level are also indicated. The summarized information is available in printed format on a yearly basis as part of the Water Resources Data Publication series. (USGS)
W89-08391

CONSTRUCTION, GEOLOGIC, AND GROUNDWATER DATA FOR OBSERVATION WELLS NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-486, 1988. 44p, 24 fig, 2 tab, 1 ref.

Descriptors: *Memphis Sand Aquifer, *Alluvium, *Lithology, *Well construction, Water levels, Landfill, Shelby County, Memphis, Tennessee.

Forty-one observation wells and two stratigraphic test holes were drilled near the Shelby County landfill in east Memphis. These wells were installed as part of an investigation on possible vertical leakage of groundwater from the alluvial aquifer into the Memphis Sand aquifer. The alluvial aquifer consists of about 45 to 55 ft of alluvial silt, sand, and gravel. This is separated from the underlying Memphis Sand aquifer by about 30 to 60 ft of silt, silty sand, and clay in the confining layer. Thirty wells completed in the alluvium were generally less than 50 ft deep. The depth to the water table ranged from about 15 to more than 45 ft below land surface. Four observation wells were completed in the upper part of the Memphis Sand aquifer. Water levels in the Memphis Sand aquifer were generally 35 to 40 ft below land surface. (USGS)
W89-08394

DETERMINATION OF BENCH-MARK ELEVATIONS AT BETHEL ISLAND AND VICINITY, CONTRA COSTA AND SAN JOAQUIN COUNTIES, CALIFORNIA, 1987,
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Blodgett, M. E. Ikehara, and W. F. McCaffrey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-498, 1988. 24p, 2 fig, 4 tab, 9 ref.

Descriptors: *Bench marks, *Elevation, Leveling, Level lines, Subsidence.

Elevations of 49 bench marks in the southwestern part of the Sacramento-San Joaquin River Delta were determined during October and November 1987. A total of 58 miles of level lines were run in the vicinity of Bethel Island and the community of Discovery Bay. The datum of these surveys is based on a National Geodetic Survey bench mark T934 situated on bedrock 10.5 mi east of Mount Diablo and near Marsh Creek Reservoir. The accuracy of these levels, based on National Geodetic Survey standards, was of first, second, and third order, depending on the various segments surveyed. Several bench marks were noted as possibly being stable, but most show evidence of instability. (USGS)
W89-08396

IMPACTS OF IRRIGATION ON INSTREAM FLOW QUANTITY: PART I. WISFOM, THE WELL IMPACT ON STREAM FLOW MODEL, AND PART II. AN ANALYTICAL MODEL DETERMINATION OF VOLUME AND RATE OF STREAM DEPLETION BY INTERMITTENTLY PUMPING WELLS,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-08402

HYDROLOGY OF THE U.S. ARMY PINON CANYON MANEUVER SITE, LAS ANIMAS COUNTY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08407

GEOHYDROLOGY, WATER QUALITY AND PRELIMINARY SIMULATIONS OF GROUNDWATER FLOW OF THE ALLUVIAL AQUIFER IN THE UPPER BLACK SQUIRREL CREEK BASIN, EL PASO COUNTY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
D. R . Buckles, and K. R. Watts.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4017, 1988. 49p, 22 fig, 8 tab, 42 ref.

Descriptors: *Geohydrology, *Alluvial aquifers, *Groundwater, *Water quality, *Model studies, *Colorado, Simulation, Black Squirrel Creek, Water use, Groundwater movement.

The upper Black Squirrel Creek basin in eastern El Paso County, Colorado, is underlain by an alluvial aquifer and four bedrock aquifers. Groundwater pumpage from the alluvial aquifer has increased since the mid-1950's, and water level declines have been substantial; the bedrock aquifers virtually are undeveloped. Groundwater pumpage for domestic, stock, agricultural, and municipal uses have exceeded recharge for the past 25 years. The present extent of the effect of pumpage on the alluvial aquifer was evaluated, and a groundwater flow model was used to simulate the future effect of continued pumpage on the aquifer. Measured water level declines from 1974 through 1984 were as much as 30 ft in an area north of Ellicott, Colorado. On the basis of the simulations, water level declines from October 1984 to April 1999 north of Ellicott might be as much as 20 to 30 ft and as much as 1 to 10 ft in most of the aquifer. The groundwater flow models provided a means of evaluating the importance of groundwater evapotranspiration at various stages of aquifer development. Simulated groundwater evapotranspiration was about 43% of the outflow from the aquifer during predevelopment stages but was less than 3% of the outflow from the aquifer during late-development stages. Analyses of 36 groundwater samples collected during 1984 indicated that concentrations of dissolved nitrite plus nitrate as nitrogen generally were large. Samples from 5 of the 36 wells had concentrations of dissolved nitrite plus nitrate as nitrogen that exceeded drinking water standards. Water from the alluvial aquifer generally is of suitable quality for most uses. (USGS)
W89-08408

METHODS TO DETERMINE TRANSIT LOSSES FOR RETURN FLOWS OF TRANSMOUNTAIN WATER IN FOUNTAIN CREEK BETWEEN COLORADO SPRINGS AND THE ARKANSAS RIVER, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08412

CONSTRUCTION, GEOLOGIC, AND WATER LEVEL DATA FOR OBSERVATION WELLS NEAR BRENTWOOD, WILLIAMSON COUNTY, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08414

MODELS, DATA AVAILABLE, AND DATA REQUIREMENTS FOR ESTIMATING THE EFFECTS OF INJECTING SALTWATER INTO DISPOSAL WELLS IN THE GREATER ALTAMONT-BLUEBELL OIL AND GAS FIELD, NORTHERN UINTA BASIN, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08425

HYDROGEOLOGY, AQUIFER CHARACTERISTICS, AND GROUNDWATER FLOW OF THE SURFICIAL AQUIFER SYSTEM, BROWARD COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. E. Fish.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4034, 1988. 92p, 46 figs, 7 tab, 44 ref.

Descriptors: *Aquifers, *Permeability, *Transmissivity, *Saline water intrusion, *Groundwater movement, *Florida, Broward County, Water resources data, Cross sections.

The surficial aquifer system, in which an unconfined groundwater flow system exists, comprises the sediments from land surface to the intermediate confining unit (formerly called the Floridan aquiclude) in Broward County, Florida. These sediments have hydraulic conductivities that range more than seven orders of magnitude from about 0.001 ft/d to more than 10,000 ft/d. The sediments are grouped into (1) the Biscayne aquifer, (2) a semiconfining unit, (3) a gray limestone aquifer in west Broward County, and (4) basal sand or clayey sand. The system is about 160 ft thick in west Broward County and more than 350 ft thick in east Broward. Transmissivities, locally variable, show a clear areal trend from greater than 300,000 sq ft/day in southeast Broward County to less than 75,000 sq ft/day in the northwest part of the county. Very high transmissivity is associated with the Biscayne aquifer. Transmissivity of the gray limestone aquifer ranged from about 20,000 to 88,000 sq ft/day. Topography, water levels, geologic framework, and water quality in west Broward County suggest past and present groundwater movement is south or southeast. Drainage and urban development have greatly altered circulation patterns in east Broward County, eliminating the original coastal groundwater ridge, causing rapid surface runoff and short groundwater flow paths, and saltwater intrusion. (USGS)
W89-08427

ESTIMATED THICKNESS AND POTENTIAL WELL YIELD OF STRATIFIED-DRIFT DEPOSITS IN THE UPPER CROTON RIVER BASIN, WESTCHESTER COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott, and D. J. Irwin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4287, 1988. 6 plates, 5 ref.

Descriptors: *Aquifers, *Glacial aquifers, *Maps, *New York, *Water resources data, *Groundwater availability, Sand aquifers, Well yield, Unconsolidated aquifers, Unconfined aquifers, Groundwater, Glacial drift.

Six maps at a scale of 1:24,000 show the estimated locations, thickness, and potential well yields of stratified-drift deposits in a 123-sq mi area of the upper Croton River basin in Westchester County, New York. The first two maps show the location of wells and springs in the northern and southern parts of the study area, respectively; the second pair shows the estimated potential yield of wells completed in the stratified-drift deposits. Most of the mapped deposits consist of sand and gravel in glacially scoured valley and recent alluvium on flood plains. Boundaries were mapped from soils interpreted to have developed from stratified-drift deposits or recent alluvium. Well-log data were used to confirm the presence of stratified drift and to estimate the thickness and potential well yield. (USGS)
W89-08430

IN-SITU CONTROL OF GROUNDWATER CONTAMINATION BY MICROBIOLOGICAL PROCESSES,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 5B.
W89-08432

VARIABLY SATURATED FLOW BETWEEN STREAMS AND AQUIFERS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. M. Peterson, and J. L. Wilson.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148506/AS, price codes: A10 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 233, September 1988. 289p, 57 fig, 5 tab, 120 ref, append. USGS state project 1345628.

Descriptors: *Groundwater, *Stream-aquifer interaction, *Aerationzone, *Groundwater recharge, *Variably saturated flow, *Model studies, *Simulation analysis, Steady state analysis, Transient analysis, Water table level, New Mexico, Mesilla Valley.

The influence of unsaturated media on stream infiltration has been examined through a series of numerical solutions of combined saturated-unsaturated (variably saturated) flow in simple stream-aquifer systems. System behavior is analyzed largely in terms of response to declines in local water table level, presumably as a result of increased pumping on a regional basis. The simulations, all of which are of a generic nature, are roughly based on existing and possible future conditions in the Mesilla Valley portion of the lower Rio Grande Valley in south-central New Mexico. Emphasis is placed on cases in which a zone of unsaturated material lies between the stream and the underlying water table. Under this set of conditions, the stream and aquifer are described as being disconnected. Factors that strongly affect the disconnection process include streambed clogging by fine-grained materials and aquifer heterogeneity. When disconnected, a stream aquifer system with a shallow water table behaves quite differently from one in which the water table is deep. Differences between these two cases, as well as with other stream-aquifer situations, are distinctly manifested in hydraulic head and moisture content distributions, pressure head profiles, system fluxes and water table behavior. (USGS)
W89-08434

SUBSURFACE GEOLOGY OF PALEOZOIC, MESOZOIC, AND CENOZOIC UNITS IN SOUTHEAST MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08452

GEOHYDROLOGIC FRAMEWORK OF THE GULF COASTAL PLAIN,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08453

OPERATING MANUAL FOR THE R200 DOWNHOLE RECORDER WITH HUSKY HUNTER RETRIEVER,
Geological Survey, NSTL Station, MS. Hydrologic Instrumentation Facility.
For primary bibliographic entry see Field 7B.
W89-08454

HYDROGEOLOGIC SETTING, WATER LEVELS, AND QUALITY OF WATER FROM SUPPLY WELLS AT THE U.S. MARINE CORPS AIR STATION CHERRY POINT, NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08457

EFFECTS OF AGRICULTURAL IRRIGATION ON WATER RESOURCES IN THE ST. JOSEPH RIVER BASIN, INDIANA, AND IMPLICATIONS FOR AQUIFER YIELD,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. G. Peters, and D. E. Renn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $6.50, microfiche $4.00. USGS Water-Resources Investigations Report 87-4273, 1988. 35p, 15 fig, 2 tab, 33 ref.

Descriptors: *Indiana, *Irrigation effects, *Surface-groundwater relations, Glacial aquifers.

During the past decade, the acreage of irrigated agricultural land in Indiana has tripled, causing public concern about competition for water and resulting in several State laws for regulating water withdrawals. The St. Joseph River basin represents less than one-tenth of the area of the State, but it contains one-third of the State's irrigated land. Irrigated land in the basin is composed of permeable soils that are underlain by productive glacial aquifers. A computer model was used to analyze the effects of maximum irrigation withdrawals on aquifer drawdown and streamflow in a 16.5 sq mi area of intensive irrigation. Simulation of maximum pumping resulted in predicted aquifer drawdowns of one-fourth of the total available drawdown. Flow in a nearby stream was decreased by 40%. Areas of most intensive irrigation in the basin also are areas that have productive aquifers and well-sustained streamflows. Aquifer yield is based on the concept of capture - the volume of increased recharge to the aquifer or decreased discharge from the aquifer that results from pumping. The high rates of capture for aquifers in the basin supply ample water for present (1982) irrigation and for substantial future development. (USGS)
W89-08462

PRELIMINARY EVALUATION OF GROUNDWATER FLOW IN BEAR CREEK VALLEY, THE OAK RIDGE RESERVATION, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08463

HYDROLOGY OF THE CITRUS PARK QUADRANGLE, HILLSBOROUGH COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08464

SUPERFUND RECORD OF DECISION: POWERSVILLE L.F., GA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5D.
W89-08472

SUPERFUND RECORD OF DECISION: SAN FERNANDO VALLEY, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08480

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 1. OVERVIEW OF THE EMISSION DATA: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
For primary bibliographic entry see Field 5B.
W89-08507

EFFECTS OF FLY ASH AND FLUE-GAS DESULFURIZATION WASTES ON GROUNDWATER QUALITY IN A RECLAIMED LIGNITE STRIP MINE DISPOSAL SITE. VOLUME II: APPENDICES,
North Dakota Mining and Mineral Resources Research Inst., Grand Forks.
For primary bibliographic entry see Field 5C.
W89-08526

SUPERFUND ENFORCEMENT DECISION DOCUMENT: LITCHFIELD AIRPORT/PHOENIX, AZ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08539

SUPERFUND RECORD OF DECISION: SAN GABRIEL, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08552

SPRING MOUND AND AIOUN MAPPING FROM LANDSAT TM IMAGERY IN SOUTH-CENTRAL TUNISIA,
Reading Univ. (England).
For primary bibliographic entry see Field 7B.
W89-08579

PHOTO-INTERPRETATION OF LANDFORMS AND THE HYDROGEOLOGIC BEARING IN HIGHLY DEFORMED AREAS, NW OF THE GULF OF SUEZ, EGYPT,
Qatar Univ., Doha.
For primary bibliographic entry see Field 7C.
W89-08580

METHODOLOGY FOR INTEGRATING SATELLITE IMAGERY AND FIELD OBSERVATIONS FOR HYDROLOGICAL REGIONALISATION IN ALPINE CATCHMENTS,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 7C.
W89-08584

APPLICATION OF REMOTE SENSING IN HYDROMORPHOLOGY FOR THIRD WORLD DEVELOPMENT: A RESOURCE DEVELOPMENT STUDY IN PARTS OF HARYANA, INDIA,
Shivaji Univ., Kolhapur (India). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W89-08591

GROUND-WATER FLOW AND QUALITY NEAR CANON CITY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
G. A. Hearne, and D. W. Litke.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Water Resources Investigations Report 87-4014, 1987. 72p, 24 fig, 9 tab, 23 ref.

Descriptors: *Groundwater movement, *Groundwater quality, Geohydrology, *Colorado, *Uranium, *Geochemistry, Path of pollutants, Alluvium, Aquifers, Water quality.

Water in aquifers that underlie the Lincoln Park area near Canon City, Colorado, contains measurable concentrations of chemical constituents that are similar to those in raffinate (liquid waste) produced by a nearby uranium ore processing mill. The objective of this study was to expand the existing geohydrologic data base by collecting additional geohydrologic and water quality, in order to refine the description of the geohydrologic and geochemical systems in the study area. Geohydrologic data were collected from nine tests wells drilled in the area between the U.S. Soil Conservation Service dam and Lincoln Park. Lithologic and geophysical logs of these wells indicated that the section of Vermejo Formation penetrated consisted of interbedded sandstone and shale. The sandstone beds had a small porosity and small hydraulic conductivity. Groundwater flow from the U.S. Soil Conservation Service dam to Lincoln Park seemed to be along an alluvium-filled channel in the irregular and relatively undescribed topography of the Vermejo Formation subcrop. North of the De Weese Dye Ditch, the alluvium becomes saturated and groundwater generally flows to the northeast. Water samples from 28 sites were collected and analyzed for major ions and trace elements; selected water samples also were analyzed for stable isotopes; samples were collected from wells near the uranium ore processing mill, from privately owned wells in Lincoln Park, and from the test wells drilled in the intervening area. Results from the quality assurance samples indicate that cross-contamination between samples from different wells was avoided and that the data are reliable. Water in the alluvial aquifer underlying Lincoln Park is mainly a calcium bicarbonate type. Small variations in the composition of water in the alluvial aquifer appears to result from a reaction of water leaking from the De Weese Dye Ditch with alluvial material. Upward leakage from underlying aquifers does not seem to be significant in determining the chemical composition of water in the alluvial aquifer. (Author's abstract)
W89-08618

GROUND-WATER FLOW AND SHALLOW-AQUIFER PROPERTIES IN THE RIO GRANDE INNER VALLEY SOUTH OF ALBUQUERQUE, BERNALILLO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
K. D. Peter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Water Resources Investigations Report 87-4015, 1987. 29p, 10 fig, 3 tab, 10 ref.

Descriptors: *Groundwater movement, *Aquifers, *Water table, *New Mexico, *Rio Grande River, *Geohydrology, Groundwater pollution, Groundwater budget, Piezometers, Hydraulic conductivity, Flow velocity, Pore water.

The purpose of this investigation was to describe the water table configuration and its temporal variations, estimate aquifer properties, and evaluate the interaction of groundwater and surface water in the inner valley of the Rio Grande in southern Albuquerque, New Mexico, where groundwater contamination is a continuing concern. The upper 150 ft of sedimentary deposits in the inner valley, mostly alluvium that consists of cobbles, gravel, sand, silt, and clay, was emphasized because of its susceptibility to contamination. A map of the water table on February 28, 1986 shows that flow generally is parallel to the river and the gradient is approximately 5 ft/mi or 0.0001. In areas affected by municipal and industrial groundwater withdrawals, declines may exceed 10 ft, and the water table gradient is as much as 20 ft/mi or 0.004. The gradient also is steeper near drains, particularly during the irrigation season. In the area east of the community of Mountainview the direction of water movement may have reversed between 1936 and 1986; flow near appears to be toward the east or southeast. Groups of four piezometers, each screened at a different depth, were monitored to describe seasonal changes of the water table. Vertical gradients between piezometers ranged from 0.014 upward to 0.047 downward from July 1985 to June 1986, but were downward most of the year, particulary during the irrigation season. The horizontal hydraulic conductivity of a 15-ft-thick clay and silt bed beneath Rio Bravo Boulevard is estimated to be 0.0001 ft/day. The average interstitial velocity down through this bed is estimated to range from about 0.0002 to 0.0005 ft/day. The fluctuations of the water table at the piezometers nearest the Rio Grande do not appear to be affected by the riverside drain. (Author's abstract)
W89-08619

PRELIMINARY ASSESSMENT OF POTENTIAL WELL YIELDS AND THE POTENTIAL FOR ARTIFICIAL RECHARGE OF THE ELM AND MIDDLE JAMES AQUIFERS IN THE ABERDEEN AREA, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-08620

GROUND-WATER RESOURCES OF FLAGLER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. S. Navoy, and L. A. Bradner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4021, 1987. 45p, 25 fig, 3 tab, 31 ref.

Descriptors: *Water quality, *Florida, *Water resources data, *Groundwater budget, *Groundwater quality, Flagler County, Potable water, Groundwater recharge, Groundwater management, Well yield, Aquifer systems, Geohydrology, Water supply, Chlorides, Brackish water, Upper Floridan Aquifer, Saline water instrusion.

Groundwater is the only significant source of potable water in Flagler County. Usable water occurs in the Upper Floridan aquifer, the intermediate population is expected to place stresses on the water resources of the county. Although rainfall averages almost 50 in/yr, most of the water leaves as evapotranspiration and streamflow. Less than 1 in/yr recharge may be occurring to the Upper Floridan aquifer, the highest yielding aquifer. The Upper Floridan aquifer consists of the Avon Park Formation, the Ocala Limestone, and the basal dolomitic limestone of the Hawthorne. Use of the Upper Floridan aquifer for public water supply is limited in most of the county because it contains marginally potable or brackish water. It is used extensively for agricultural irrigation. The intermediate aquifer system consists of thin, discontinues lenses of sand, shell, and limestone between clays overlying the Floridan aquifer system. The intermediate aquifer system is an important part of the public water supply of the county because of the good quality of the water. The intermediate aquifer system has variable yields because of the discontinuous lenses. The surficial aquifer system is composed of sand and shell with varying fractions of finer materials. Well yields are small in the west and central parts of Flagler County, but the surficial aquifer system is an adequate source of domestic supply on the barrier island. A zone of freshwater in the surficial aquifer system is very important in the Hammock area, being the local source of most domestic supply in the area. Changes in hydrologic conditions from the 1950's include a long-term decline in water levels in the Upper Floridan aquifer coincident with lower-than-average rainfall and a greater seasonal fluctuation of water levels. Chloride concentrations of water in the Upper Floridan aquifer do not appear to have changed significantly, presently ranging from 7 to 3,700 mg/L. Development will place stress on the aquifers and may result in upconing of brackish water in pumping centers and in lateral saltwater intrusion in coastal areas. (Author's abstract)
W89-08621

PRELIMINARY ASSESSMENT OF WATER QUALITY AND ITS RELATION TO HYDROGEOLOGY AND LAND USE: POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
C. Barton, E. F. Vowinkel, and J. P. Nawyn.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4023, 1987. 79p, 23 fig, 16 tab, 69 ref.

Descriptors: *Groundwater quality, *Groundwater management, *Geohydrology, *Water quality, *Land use, *Aquifer systems, *New Jersey, Environmental effects, Water pollution sources, Dissolved oxygen, Nitrates, Nitrites, Organic compounds.

The relation of water quality to geohydrology and land use is evaluated with the Kruskal-Wallis test and frequency-of-detection method using water quality analyses from 71 wells screened in or near the outcrop of the northern part of the Potomac-Raritan-Magothy aquifer system in New Jersey. The water quality network is evaluated for variations in hydrogeologic conditions at sampled wells. When the relation of geohydrologic factors to water quality are evaluated independent of land use, shallow wells had the highest specific conductance and the highest concentrations of most major ions; wells screened in the unconfined part of the aquifer system had a higher concentration of dissolved organic carbon than wells screened in the confined part of the aquifer system. Statistically significant differences in the water quality among land use groups are determined when two methods are used to classify land use at a sampled well--a predominant land use method and a presence-absence method. In groundwater from undeveloped land, dissolved oxygen (DO) and nitrate concentrations were lowest, most trace metals concentrations were highest, and phenols were detected most frequently. In agricultural land, major ions and most trace metal concentrations were lowest, DO and copper concentrations were highest, and pesticides were most frequently detected. In urban land, nitrate concentrations were highest and orthophosphate, nitrite, and purgeable organic compounds were detected most frequently. These relations suggest that water quality is influenced by both natural land cover and human activities specific to each land use. Statistical relations between water quality and land use in the northern area are compared to those from 179 wells in the outcrop of the same aquifer system in southern New Jersey. The water quality/land use relations are different in each area, especially with respect to most major ions, trace metals, and nutrients. These differences suggest that there are different processes controlling groundwater quality in each area and that these processes may be related to the presence of a Pinelands outlier in the northern area and induced recharge of the aquifer system from the Delaware River in the southern area. (Author's abstract)
W89-08622

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL-FISCAL YEARS 1983, 1984, AND 1985,
For primary bibliographic entry see Field 5E.
W89-08626

RELATION BETWEEN GROUND-WATER AND SURFACE WATER IN THE HILLSBOROUGH RIVER BASIN, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-08627

POTENTIAL FOR POLLUTION OF THE UPPER FLORIDAN AQUIFER FROM FIVE SINKHOLES AND AN INTERNALLY DRAINED BASIN IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08629

RECONNAISSANCE OF WATER QUALITY IN THE HIGH PLAINS AQUIFER BENEATH AGRICULTURAL LANDS, SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Stullken, J. K. Stamer, and J. E. Carr.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4003, 1987. 25p, 5 fig, 6 tab, 31 ref.

Descriptors: *Groundwater quality, *High Plains aquifer, *Land use, *Aquifers, *Agricultural hydrology, *Kansas, *Agriculture, Ecological effects, Statistical analysis, Sodium, Alkalinity, Irrigation, Nitrites, Fertilizers, Nitrates, Pesticides, Irrigation wells, Atrazine, Groundwater movement, Groundwater pollution, Surveys.

The High Plains of western Kansas was one of 14 areas selected for preliminary groundwater quality reconnaissance by the U.S. Geological Survey's Toxic Waste--Groundwater Contamination Program. The specific objective was to evaluate the effects of land used for agriculture (irrigated cropland and non-irrigated rangeland) on the water in the High Plains aquifer. Conceptual inferences, based on the information available, would lead one to expect groundwater beneath irrigated cropland to contain larger concentrations of sodium, sulfate, chloride, nitrite plus nitrate, and some water soluble pesticides than water beneath non-irrigated land (range-land) The central part of the Great Bend Prairie, an area of about 1,800 sq mi overlying the High Plains aquifer in south-central Kansas, was selected for the study of agricultural land use because it has sand soils, a shallow water table, relatively large annual precipitation, and includes large areas that are exclusively irrigated cropland or non-irrigated rangeland. As determined by a two-tailed Wilcoxon rank-sum test, concentrations of sodium and alkalinity were significantly larger at the 95% confidence level for water samples from beneath irrigated cropland than from beneath rangeland. No statistically significant difference in concentrations of sulfate, chloride, nitrite plus nitrate, and ammonia, was detected. Concentrations of 2,4-D found in water samples from beneath the rangeland were larger at the 99% confidence level as compared to concentrations of 2,4-D in samples from beneath irrigated cropland. Larger concentrations of sodium and alkalinity were found in water beneath irrigated cropland, and the largest concentration of the pesticide atrazine (triazines were found in three samples) was found in water from the only irrigation well sampled. The sodium and atrazine concentrations found in water from the irrigation well support the premise that water-level drawdown develops under irrigated fields. This diverts the natural groundwater flow patterns, so that pumpage may cause recycling and subsequent concentration of leachates from the land surface. (Author's abstract)
W89-08631

GROUND-WATER QUALITY AND GEOCHEMISTRY OF LAS VEGAS VALLEY, CLARK COUNTY, NEVADA, 1981-83: IMPLEMENTATION OF A MONITORING NETWORK,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08632

PRELIMINARY APPRAISAL OF THE EFFECTS OF LAND USE ON WATER QUALITY IN STRATIFIED-DRIFT AQUIFERS IN CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08633

STATISTICAL ANALYSIS OF AQUIFER-TEST RESULTS FOR NINE REGIONAL AQUIFERS IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
A. Martin, and D. A. Early.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4001, 1987. 26p, 20 fig, 3 tab, 1 plate, 9 ref.

Descriptors: *Pumping tests, *Aquifer testing, *Louisiana, *Aquifers, Jasper Aquifer, Catehoula Aquifer, Cockfield Aquifer, Sparta Aquifer, Carrizo Aquifer, Wilcox Aquifer, Evangeline Aquifer, Computers, Hydraulic conductivity, Permeability, Pleistocene Aquifer, Geohydrology, Alluvial aquifer, Statistical analysis.

This report, prepared as part of the Gulf Coast Regional Aquifer-System Analysis project, presents a compilation, summarization, and statistical analysis of aquifer-test results for nine regional aquifers in Louisiana. These are from youngest to oldest: The alluvial, Pleistocene, Evangeline, Jasper, Catahoula, Cockfield, Sparta, Carrizo, and Wilcox aquifers. Approximately 1,500 aquifer tests in U.S. Geological Survey files in Louisiana were examined and 1,001 were input to a computer file. Analysis of the aquifer test results and plots that describe aquifer hydraulic characteristics were made for each regional aquifer. Results indicate that, on the average, permeability (hydraulic conductivity) generally tends to decrease from the youngest aquifers to the oldest. The most permeable aquifers in Louisiana are the alluvial and Pleistocene aquifers; whereas, the least permeable are the Carrizo and Wilcox aquifers. (Author's abstract)
W89-08636

HYDROGEOLOGY AND PRELIMINARY ASSESSMENT OF REGIONAL FLOW IN THE UPPER CRETACEOUS AND ADJACENT AQUIFERS IN THE NORTHERN MISSISSIPPI EMBAYMENT,
Geological Survey, Nashville, TN. Water Resources Div.
J. V. Brahana, and T. O. Mesko.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4000, 1988. 65p, 39 fig, 6 tab, 119 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Aquifers, *Mississippi River, Wilcox Aquifer, Upper Cretaceous Aquifer, Hydraulic models, Leakage, Groundwater quality, Simulation analysis.

On a regional scale, the groundwater system of the northern Mississippi embayment is composed of a series of nonindurated clastic sediments that overlie a thick sequence of Paleozoic carbonate, sandstones, and shales. The units that comprise the geohydrologic framework of this study are the alluvium-lower Wilcox Aquifer the Midway confining unit, the Upper Cretaceous aquifer, the Cretaceous-Paleozoic confining unit, and the Ozark-St. Francois aquifer. The Upper Cretaceous aquifer of Late Cretaceous age is the primary focus of this investigation; the study is part of the Gulf Coast Regional Aquifer-System Analysis. A four layer finite-difference groundwater flow model enabled testing of alternative boundary concepts and provide a refined definition of the hydrologic budget of the deep aquifers. The alluvium-lower Wilcox aquifer, the Upper Cretaceous aquifer, and the Ozark-St. Francois aquifer form layers 2 through 4, respectively. Layer 1 is an inactive layer of constant heads representing shallow water levels, which are a major control on recharge to and discharge from the regional system. A matrix of leakance values simulates each confining unit, allowing vertical interchange of water between different aquifers. The model was calibrated to 1980 conditions by using the assumption that 1980 was near steady-state conditions; it was calibrated to simulate observed heads were found to be most sensitive to pumping, and least sensitive to the leakance. By using all available water quality and water level data, alternative boundary conditions were tested by comparing model simulated heads to observed heads. The results of the early modeling effort also contribute to a better understanding of the regional hydrologic budget, indicating that: upward leakage from the Ozark-St. Francois aquifer to the Upper Cretaceous aquifer is about 43 cu ft/sec; upward recharge of about 68 cu ft/sec occurs to the lower Wilcox-alluvium aquifer from the Upper Cretaceous aquifer; and the Midway is

an effective regional confining unit. (Author's abstract)
W89-08637

SELECTED GEOHYDROLOGIC CHARACTERISTICS OF THE PATAPSCO AQUIFERS AT CHALK POINT, PRINCE GEORGES COUNTY, MARYLAND,
Maryland Geological Survey, Baltimore.
F. K. Mack.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report No. 88-02-4, 1088. 36p, 16 fig, 5 tab, 11 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *Patapsco Aquifer, *Maryland, Silt, Clays, Groundwater budget, Transmissivity, Groundwater level, Groundwater depletion, Groundwater quality, Iron.

The Cretaceous Patapsco Formation at Chalk Point Maryland consists of thick beds of clay and silt that separate sandy intervals of varying lateral extent. Water bearing characteristics of three sand layers, the tops of which are at depths of about 850 ft, 1,000 ft, and 1,500 ft, have been estimated by pumping tests. The estimated transmissivity of each was 570, 1,500, and 820 sq ft/day, respectively, at the site tested. Water levels in the '850-ft' sand declined from 10 ft above sea level to 17 ft below sea level from 1974 to 1986. Water levels in the '1,000-ft' sand, which has been pumped since 1975 at rates ranging from zero to 0.8 million gal/day, have declined from 15 ft above sea level to 23 ft below sea level from 1973 to 1986. Water levels in the sea level to 1 ft below sea level from 1973 through 1986. Chemical analyses of water samples show that except for the slightly high concentrations of dissolved iron in the '850-ft' and '1,000-ft' sands, all constituents tested met the drinking water standards of the U.S. EPA. (Author's abstract)
W89-08639

RECONNAISSANCE OF THE GROUNDWATER, SURFACE WATER SYSTEM IN THE ZEKIAH SWAMP RUN BASIN, CHARLES AND PRINCE GEORGES COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
H. T. Hopkins, G. T. Fisher, and L. J. McGreevy.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4097, 1986. 48p, 16 fig, 10 tab, 1 plates, 29 ref, append.

Descriptors: *Groundwater level, *Zekiah Swamp, *Water table, *Surface-groundwater relations, Maryland, Alluvial aquifers, Aquifers, Streams, Confined aquifers, Groundwater movement, Stream discharge, Hydrogen ion concentration, Specific conductivity, Dissolved oxygen, Temperature, Evapotranspiration.

The water table in the alluvium of the Zekiah Swamp Run valley in southern Maryland is above stream level during most of the year and the alluvial aquifer contributes water to the stream. During the summer, however, high evapotranspiration sometimes lowers the water table below the stream level. Water then moves from the stream to the alluvium and, at times, reaches of the stream become dry. Pumping from the confined aquifers has caused water levels to decline several tens of ft, which has increased the downward gradient between the water-table aquifer and the underlying confined aquifers. Three synoptic surveys of base flow show areal and temporal variations in stream discharge, pH, specific conductance, dissolved oxygen, and temperature. April 1984 base flows were high (141 cu ft/sec, at the Route 6 gage) because of high precipitation during March. July 1983 base flows were low (2.35 cu ft/sec at the Route 6 gage) and showed significant loss of streamflow because of high antecedent evapotranspiration. Estimates of inflow and outflow of the Zekiah Swamp Run basin above Route 6 during the 1984 water year include: Precipitation, 50.21 in; stream outflow, 20.10 in; shallow groundwater underflow, 0.1 in; stream outflow, 20.10 in; shallow groundwater underflow, 0.1 in; and evapotranspiration, 33 in. A streamflow budget of a 5.1 mi area of the valley of Zekiah Swamp Run between Routes 5 and 6, during the April 1984 survey and a loss of almost 5 cu ft during the July 1983 survey. (Author's abstract)
W89-08643

SHALLOW GROUND-WATER RESOURCES IN THE GRAND STRAND OF SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
G. K. Speiran, and W. F. Lichtler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4099, 1986. 31p, 9 fig, 5 tab, 10 ref.

Descriptors: *Water resources data, *Groundwater budget, *Aquifers, *South Carolina, *Coastal aquifers, Groundwater level, Groundwater recharge, Rainfall, Potentiometric level, Calcium, Bicarbonates, Chlorides.

The shallow aquifers that underlie the Grand Strand of South Carolina average approximately 60 to 400 ft thick and have variable productivity with some wells producing little water and others producing several hundred gal/min. These aquifers are separated from the underlying Black Creek aquifer by a 200 ft to 300 ft thick clay confining unit. The shallow aquifers are recharged by local rainfall and discharge primarily into the Atlantic Ocean, the Intracoastal Waterway, and other surface waters. In the North Myrtle Beach area a vertical difference in potentiometric levels of < 1 ft was observed within the shallow aquifers in 1983. However, the difference in potentiometric levels between the shallow aquifers and the Black Creek aquifer was probably from 25 ft to > 50 ft. The quality of groundwater is also variable. Calcium and bicarbonate are generally the predominant ions in solution as a result of the dissolution of calcite in the aquifer sediments. Concentrations of chloride may be high in the vicinity of the salty surface waters. Concentrations of iron range from 5 to 35,000 micrograms/L, but generally $< 2{,}000$ micrograms/L. (Author's abstract)
W89-08644

HYDROLOGIC AND GEOLOGIC ANALYSIS OF TWO WELLS IN MARION COUNTY, SOUTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
M. S. Reid, R. A. Renken, R. L. Wait, W. R. Aucott, and R. W. Lee.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4102, 1986. 20p, 3 fig, 4 tab, 2 plates, 17 ref.

Descriptors: *Geohydrology, *Wells, *South Carolina, *Hydrologic data, *Water resources data, Groundwater budget, Geophysics, Groundwater level, Chemical analysis, Groundwater quality, Lithologic logs, Core logging.

Two test wells were drilled in Marion County, South Carolina in 1982. Well MRN 77 (Marion 77) was drilled to a depth of 365 ft and was used as an observation well in the Black Creek aquifer and to supply water during drilling of the deeper well. MRN 78 (Marion 78) was drilled and cored through the entire thickness of Coastal Plain sediments into the underlying basement rock to a depth of 1,225 ft. Data from the wells include description of the core samples from MRN 78, geophysical logs, zone water levels, chemical analysis of the water sampled and results of tests for mineral content. Head in MRN 78 increases with depth. The waters sampled were all sodium bicarbonate type except for the deepest zone (1,120-1,140 ft) sampled in MRN 78, which yielded a sodium chloride type water. (Lantz-PTT)
W89-08645

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA: PHASE 3--DEVELOPMENT OF A THREE-DIMENSIONAL DIGITAL GROUND-WATER FLOW MODEL FOR STORAGE UNIT I OF THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, Sacramento, CA. Water Resources Div.
P. Martin, and C. Berenbrock.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4103, 1986. 58p, 21 fig, 3 tab, 10 ref.

Descriptors: *California, *Model studies, *Groundwater quality, *Santa Barbara, *Geohydrology, *Groundwater movement, Hydrologic models, Groundwater storage, Wells, Municipal water, Mathematical models, Groundwater management.

Water-bearing rocks within the 7 sq mi of Storage Unit I of the Santa Barbara Groundwater Basin, consist of unconsolidated deposits that range in thickness from < 300 ft along the north perimeter of the unit to $> 1{,}000$ ft near the Pacific Ocean. The groundwater system was simulated as two horizontal layers separated by a confining bed. The model boundaries coincide with mapped faults on all sides. The faults were considered no-flow boundaries except for the offshore fault that forms the south boundary. This boundary was simulated as a general-head boundary, which allows water to move into and out of the modeled area. The model was calibrated by simulating both steady-state conditions (approximated by July 1978 and February 1983 water levels) and transient-state conditions (represented by May 1978 through December 1979 water level changes). The calibrated model was then used to simulate the period from January 1980 through December 1983 in order to verify the model. Model results generally closely matched measured data throughout Storage Unit I. During the transient and verification simulations, 9,980 acre-ft of groundwater was pumped from Storage Unit I for municipal use. Results of the model indicate that 42% (4,190 acre-ft) of the water pumped from the system was withdrawn from storage, 33% (3,290 acre-ft) was derived from changes in underflow across the offshore fault, and 25% (2,500 acre-ft) was derived from decreased groundwater discharge to drains. The model simulated that municipal pumpage induced about 1,380 acre-ft of water to move across the offshore fault toward Storage Unit I. Several model simulations were used to estimate aquifer response to different municipal pumpage patterns that could be used as management alternatives. Results of the simulations indicate that spreading municipal pumpage more evenly throughout Storage Unit I, by increasing the number of wells while reducing the pumping rate at the individual wells to maintain the same total pumpage, significantly reduces the inflow of groundwater across the offshore fault. (Author's abstract)
W89-08646

EFFECTS ON GROUND-WATER QUALITY OF SEEPAGE FROM A PHOSPHATIC CLAYEY WASTE SETTLING POND, NORTH-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08649

CHANGES IN GROUND-WATER QUALITY RESULTING FROM SURFACE COAL MINING OF A SMALL WATERSHED IN JEFFERSON COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08650

GEOHYDROLOGY OF THE WELLINGTON-ALLUVIAL AQUIFER SYSTEM AND EVALUATION OF POSSIBLE LOCATIONS OF RELIEF WELLS TO DECREASE SALINE GROUND-WATER DISCHARGE TO THE SMOKY HILL AND SOLOMON RIVERS, CENTRAL KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
J. B. Gillespie, and G. D. Hargadine.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4110, 1986. 31p, 13 fig, 19 ref.

Descriptors: *Geohydrology, *Saline water, *Water quality control, *Aquifers, *Saline water intrusion, *Groundwater movement, Wellington Aquifer, Brine, Groundwater quality, Relief wells, Surface-groundwater relations.

Saline water discharges from the alluvial aquifer into the Smoky Hill and Solomon Rivers between New Cambria and Solomon in central Kansas. Chloride concentrations in the Smoky Hill River sometimes exceed 1,000 mg/L during low flow conditions. The source of saline water is the underlying Wellington aquifer, a zone of halite and gypsum dissolution, subsidence, and collapse along the eastern margin of the Permian Hutchinson Salt Member of the Wellington Formation. Locally, brine from the Wellington aquifer flows upward through collapse structures in the confining layer into the overlying alluvium. Estimated brine discharge averages about 0.8 cu ft/sec. Control of the saline groundwater discharge to the Smoky Hill and Solomon Rivers is desirable to improve the quality of water in the rivers. The upward discharge of natural brine into the alluvium could be partly controlled by relief wells installed in the Wellington aquifer. The wells need to be located in the area of greatest saline groundwater discharge to the rivers and near the eastern end of the Wellington aquifer between New Cambria and Solomon. The relief wells could be pumped just enough to reverse the hydraulic gradient between the Wellington and alluvial aquifers, decreasing the upward flow of brine into the alluvium and, into the rivers. The brine could be disposed into brine aquifers underlying the area at depth or pumped into surface evaporation-storage reservoirs. (Author's abstract)
W89-08651

POTENTIOMETRIC SURFACE, GROUNDWATER WITHDRAWALS, AND RECHARGE AREA FOR THE NANAFALIA-CLAYTON AQUIFER IN ALABAMA, FALL 1982,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. S. Williams, S. S. DeJarnette, and M. Planert.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4119, 1986. 1p (map), 4 fig, 1 tab, 5 ref.

Descriptors: *Potentiometric level, *Nanafalia-Clayton aquifer, *Hydrologic maps, *Maps, *Geohydrology, *Alabama, *Aquifer systems, Aquifers, Groundwater depletion, Groundwater recharge, Groundwater budget.

The U.S. Geological Survey began a nationwide program in 1978, termed Regional Aquifer-System Analysis (RASA), to study a number of the major aquifer systems that provide a significant part of the country's water supply. One of the aquifer systems chosen for study was the thick and extensive sequence of sands for Cretaceous and early Tertiary age that underlies the Coastal Plain of the southeastern United States. This system, which extends from Mississippi eastward to South Carolina, is called the Southeastern Coastal Plain aquifer system. It can be divided geohydrologically into several separate aquifers. This map, one of a series that portray the potentiometric surface, groundwater withdrawal, and recharge areas for the aquifers in Alabama that are included in the regional system, deals with the Nanafalia-Clayton aquifer. (Lantz-PTT)
W89-08653

POTENTIOMETRIC SURFACE, GROUNDWATER WITHDRAWALS, AND RECHARGE AREA FOR THE LISBON AQUIFER IN ALABAMA, FALL 1982,
Geological Survey, Tuscaloosa, AL.
J. S. Williams, M. Planert, and S. S. DeJarnette.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4120, 1986. 1p (map), 3 fig, 1 tab, 6 ref.

Descriptors: *Potentiometric level, *Lisbon Aquifer, *Hydrologic maps, *Maps, *Geohydrology, *Alabama, *Aquifer systems, Aquifers, Groundwater depletion, Groundwater recharge, Groundwater budget.

The U.S. Geological Survey began a nationwide program in 1978, termed Regional Aquifer-System Analysis (RASA), to study a number of the major aquifer systems that provide a significant part of the country's water supply. One of the aquifer systems chosen for study was the thick and extensive sequence of sands of Cretaceous and early Tertiary age that underlies the Coastal Plain of the southeastern United States. This system, which extends from Mississippi eastward to South Carolina, is called the Southeastern Coastal Plain aquifer system. It can be divided geohydrologically into several separate aquifers. The map presented, one of a series that portray the potentiometric surface, groundwater withdrawals, and recharge areas for aquifers in Alabama that are included in the regional system, deals with the Lisbon aquifer. (Lantz-PTT)
W89-08654

SIMULATION OF GROUND-WATER FLOW AND INFILTRATION FROM THE SUSQUEHANNA RIVER TO A SHALLOW AQUIFER AT KIRKWOOD AND CONKLIN, BROOME COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
R. M. Yager.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4123, 1986. 70p, 28 fig, 11 tab, 2 plates, 20 ref, append.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Model studies, *Infiltration, *Susquehanna River, *Aquifers, New York, Hydrologic models, Wells, Hydraulic conductivity, Piezometric head, Groundwater depletion, Groundwater budget.

A four-layer finite difference model was developed to simulate groundwater flow and induced infiltration to an aquifer underlying the Susquehanna River in the Towns of Kirkwood and Conklin in Broome County, NY. The aquifer consists of sand and gravel deposited in an ancestral river valley during the recession of glacial ice and is in hydraulic connection with the Susquehanna River. In 1984, he aquifer supplied 1.2 million gal/day to well fields in Kirkwood and Conklin. Horizontal hydraulic conductivity of the sand and gravel in the calibrated model ranges from 50 to 10,000 ft/day. Vertical hydraulic conductivity ranges from 1.0 to 80 ft/day. The riverbed thickness was estimated from results of piezometer tests to be 2 ft; the hydraulic conductivity of the riverbed was estimated to be 0.2 ft/day. Root-mean-square differences between computed drawdowns and drawdowns measured in observation wells and piezometers during aquifer tests at the Kirkwood well field ranged from 17% to 24%. The sizes of the well field catchment areas were estimated from a model generated flow net showing the direction and rate of groundwater flow. The Kirkwood catchment area was estimated to be 250 acres, and the Conklin catchment area was 51 acres. Groundwater budgets computed by steady-state simulations showed that 58% of the groundwater withdrawn by the Kirkwood well field is derived from the Susquehanna River during the periods of low river stage and low recharge. The factor to which induced-infiltration rate and size of well field catchment areas are most sensitive, is riverbed hydraulic conductivity. (Author's abstract)
W89-08655

GEOHYDROLOGY AND MODEL ANALYSIS OF STREAM-AQUIFER SYSTEM ALONG THE ARKANSAS RIVER IN KEARNY AND FINNEY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08658

KANSAS GROUND-WATER OBSERVATION-WELL NETWORK, 1983,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-528, 1983. 57p, 2 fig, 1 tab, 15 ref.

Descriptors: *Kansas, *Groundwater, *Data collections, *Observation wells, Networks, Data acquisition, Groundwater level, Groundwater budget.

The locations of 1,940 selected wells in 72 counties, which comprised the Kansas groundwater observation-well network 1983, are listed. Water level measurements are made in these wells on a continuous, monthly, quarterly, or annual basis. Data collected from the observation well network are stored in a computer and have been published in various formats. The observation well network provides a continuing program of collection, analysis, and storage of groundwater level data required to define and describe the groundwater resources of Kansas. Accurate groundwater information is the single most important item for management of the State's groundwater resource and is required for the application of research to the solution of groundwater related problems. The information provided by the observation well network is needed at all management levels to aid in the evaluation and conservation of groundwater. (Lantz-PTT)
W89-08660

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN SOUTH DAKOTA AND PARTS OF ADJACENT STATES,
For primary bibliographic entry see Field 7C.
W89-08664

GROUND-WATER DATA FOR GEORGIA, 1982,
Geological Survey, Doraville, GA. Water Resources Div.
H. R. Stiles, and S. E. Matthews.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-678, 1983. 147p, 71 fig, 32 ref.

Descriptors: *Groundwater level, *Hydrologic data collections, *Georgia, *Data collections, *Water resources data, Wells, Groundwater recharge, Groundwater depletion, Groundwater budget, Hydrographs, Water level, Groundwater quality, Chlorides, Coastal aquifers, Saline water intrusion.

Continuous water level records from 105 wells, and more than 2,000 water level measurements made in Georgia during 1982 provided the basic data for this report. Selected wells illustrate the effects that changes in recharge and pumpage have had on the various groundwater resources in the State. Daily mean water levels are shown in hydrographs for 1982. Monthly means are shown for the 10-yr period 1973 and 1982. Mean annual water levels ranged from 10 ft higher to 1 ft lower in 1982 than in 1981. This is a significant reversal of the downward trend of the past few years. Water quality samples are collected periodically throughout Georgia and analyzed as part of areal and regional groundwater studies. Along the coast, chloride concentrations have remained stable in the Savannah area, but invasion of brackish water into the aquifer has increased the chloride concentration at Brunswick. (Author's abstract)
W89-08665

GROUNDWATER QUALITY DATA FOR OKLAHOMA-1981,
Geological Survey, Oklahoma City, OK. Water

Resources Div.
D. M. Ferree.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-686, 1983. 78p.

Descriptors: *Water quality, *Groundwater quality, *Hydrologic data collections, *Oklahoma, Data collections, Groundwater level, Groundwater budget, Specific conductivity, Hydrogen ion concentration, Temperature, Calcium, Magnesium, Sodium, Potassium, Alkalinity, Sulfates, Chlorides, Fluorides.

The U.S. Geological Survey (USGS) has collected data on Oklahoma's groundwater resources since 1934. Most of these data were collected as part of specific groundwater studies conducted in cooperation with various Federal, State, and local agencies. Groundwater quality data (specific conductivity, pH, temperature, hardness, acidity, dissolved calcium, dissolved magnesium, dissolved sodium, sodium, potassium, alkalinity, sulfates, chlorides, fluorides), as well as data on construction, yield, water levels, and other physical well parameters collected prior to 1981 are available from the USGS. The report contains groundwater quality data collected in 1981 from 524 sites in 15 counties, predominantly in eastern Oklahoma. (Lantz-PTT)
W89-08667

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1983,
Geological Survey, Denver, CO. Water Resources Div.
G. L. Barr, and G. R. Schiner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-547, 1983. 1p (map), 1 fig, 1 map, 2 ref.

Descriptors: *Potentiometric level, *Floridan Aquifer, *Hydrologic maps, *Maps, *Florida, Data collections, Groundwater level, Groundwater budget.

Maps of the potentiometric surface of the Floridan aquifer in west-central Florida are prepared semiannually by the U.S. Geological Survey in cooperation with the Southwest Florida Water Management District. Maps for May and September show, respectively, the potentiometric surface of the normally expected annual low and high water level conditions. This report shows the potentiometric surface of the Floridan aquifer for May 1983. Water level measurements were made during May 16-27. The map represents water level conditions when groundwater withdrawals for agricultural use are high, before the beginning of the summer rainy season. Therefore, the potentiometric surface is near its lowest level for the year. (Lantz-PTT)
W89-08668

PRELIMINARY EVALUATION OF THE KNOX GROUP IN TENNESSEE FOR RECEIVING INJECTED WASTES,
Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4304, 1986. 20p, 6 fig, 5 tab, 10 ref.

Descriptors: *Injection wells, *Waste disposal, *Groundwater quality, Groundwater pollution, Drinking water, Aquifers, Tennessee, Knox group.

The EPA is authorized under the Safe Drinking Water Act to protect underground sources of drinking water from contamination. However, an aquifer may be exempted from protection and used for injected wastes where the aquifer meets criteria established in the EPA's Underground Injection Control program. The Knox Group in Middle and West Tennessee occurs primarily in the subsurface, and the top of the Knox Group ranges from about 350 to 3,000 feet below land surface. The upper part of the Knox Group (upper Knox aquifer) is an important source of drinking water in parts of the Central Basin and the Highland Rim provinces. The lower part of the Knox Group is currently being used for injected wastes at New Johnsonville on the western Highland Rim and at Mount Pleasant in the Central Basin. There is no known contamination of the upper Knox aquifer but contamination of the lower part of the Know Group is known at three waste injection well sites. (Lantz-PTT)
W89-08669

POSSIBLE CHANGES IN GROUND-WATER FLOW TO THE PECOS RIVER CAUSED BY SANTA ROSA LAKE, GUADALUPE COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08670

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SAN JUAN STRUCTURAL BASIN, NEW MEXICO, COLORADO, ARIZONA, AND UTAH,
Geological Survey, Albuquerque, NM. Water Resources Div.
G. E. Welder.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4294, 1986. 23p, 8 fig, 27 ref.

Descriptors: *Geohydrology, *San Juan Aquifer, *Aquifer systems, Colorado, Arizona, Utah, Aquifers, Surface-groundwater relations, Groundwater recharge, Groundwater budget, Water use, Groundwater quality.

The San Juan structural basin is an 18,000 sq mi area that contains several extensive aquifers. The basin includes three surface drainage basins and parts of New Mexico, Colorado, Arizona, and Utah. Surface water in the area is fully appropriated, and the steadily increasing demand for groundwater has resulted in water supply concerns. Competition is great between mining and electric power companies, municipalities, and Indian communities for the limited groundwater supplies. This report outlines a 4-year plan for a study of the regional aquifer system in the San Juan structural basin. The purposes of the study are to define and understand the aquifer system; to assess the effects of groundwater use on the aquifers and streams; and to determine the availability and quality of groundwater in the basin. (Author's abstract)
W89-08673

POTENTIAL FOR LEAKAGE AMONG PRINCIPAL AQUIFERS IN THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Memphis, TN. Water Resources Div.
D. D. Graham, and W. S. Parks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4295, 1986. 46p, 21 fig, 3 tab, 71 ref.

Descriptors: *Aquifers, *Leakage, *Groundwater movement, *Geohydrology, *Memphis, *Tennessee, Hydraulic conductivity, Geohydrology, Carbon radioisotopes, Water table, Water temperature.

The principal aquifers in the Memphis area consist primarily of sand or sand and gravel, and the confining beds consist of clay, silt, sand, and lignite. The Jackson Formation and upper part of the Claiborne Group serve as the confining bed separating the water table aquifers from the Memphis Sand; the Flour Island Formation separates the Memphis Sand from the Fort Pillow Sand. Differences in total hydraulic head among the principal aquifers in the Memphis urban area result in vertical hydraulic gradients which create a potential for inter-aquifer exchange of water. Throughout this area, the gradient is downward from the water table aquifers to the Memphis Sand. In the central part of the Memphis urban area, the vertical hydraulic gradient is upward from the Fort Pillow Sand to the Memphis Sand, and in the eastern and western parts, it is downward from the Memphis Sand to the Fort Pillow Sand. The vertical distribution of carbon-14 data for water from the fluvial deposits, Memphis Sand, and Fort Pillow Sand shows an increase in the relative age of the water with depth. The areal distribution of carbon-14 data for water from the upper part of the Memphis Sand indicates that relatively recent water has been brought into the major cone of depression in the potentiometric surface of the Memphis Sand, either by horizontal movement or from downward vertical leakage. The normal, near-surface geothermal gradient in the Memphis area was determined to be 0.6 C/100 ft. Deviations from the normal geothermal gradient, in areas affected by intense pumping from the Memphis Sand, indicate that downward vertical leakage occurs from the water table aquifers through the Jackson-upper Claiborne confining bed to the Memphis Sand. The velocity of downward vertical leakage of water from the Memphis Sand through the Flour Island confining bed to the Fort Pillow Sand was determined to be 0.0066 ft/day by analysis of borehole temperature data from an observation well in the northeastern part of the Memphis area. From this velocity and the head difference between the Memphis Sand and the Fort Pillow Sand at this locality, the hydraulic conductivity of the Flour Island confining bed was determined to be 0.00114 ft/day. (Lantz-PTT)
W89-08674

SIMULATION OF THE FLOW SYSTEM OF BARTON SPRINGS AND ASSOCIATED EDWARDS AQUIFER IN THE AUSTIN AREA, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
R. M. Slade, L. Ruiz, and D. Slagle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4299, 1985. 49p, 20 fig, 6 tab, 21 ref.

Descriptors: *Simulation analysis, *Flow profiles, *Groundwater movement, *Groundwater depletion, *Edwards Aquifer, Barton Springs, Texas, Model studies, Tranmissivity, Hydraulic conductivity, Specific yield, Aquifers, Discharge, Potentiometric level.

A digital model of two-dimensional groundwater flow was used to estimate the hydraulic properties of the Edwards Aquifer in a 151 sq mi area near Austin, Texas. The transmissivity, hydraulic conductivity, and specific yield were estimated for the part of the aquifer that discharges at Barton Springs in Austin. The aquifer is composed of the Edwards and overlying Georgetown Limestones of Cretaceous age and ranges in thickness from about 100 ft to about 450 ft. More than 60 years of discharge measurements and 5 years of gaged discharge for Barton Springs were used to adjust springflow for the simulations. Barton Springs accounts for about 96% of springflow from the study area and 90% of the total discharge. The remaining discharge was pumpage from wells which was entered in the model. Four years of gaged recharge were used in the simulations. The potentiometric surfaces used by the models were constructed from water level measurements in as many as 75 wells. The transmissivity was calibrated through steady-state simulations that used the mean value of recharge and mean potentiometric surface to represent average conditions for the aquifer. The transmissivities vary from about 100 sq ft/day in the western part of the aquifer to $>$ 1 million sq ft/day near Barton Springs. Specific yield was calibrated through transient-state simulations for 5 consecutive months using time-dependent data for recharge, discharge, and water levels. The mean specific yield for the aquifer is 0.014 and ranges from 0.008 to 0.064. Additional aquifer properties used in the simulations include storage coefficient, altitudes of the base and top of the aquifer, and hydraulic conductivity. A simulation for the year 2000 using projected pumping rates for municipal,

industrial, agricultural, and domestic supplies indicates that the aquifer would be dewatered in the southwestern part of the study area and have large declines in the southeastern part of the study area. (Author's abstract)
W89-08677

SURFACE-WATER HYDROLOGY OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08678

COMPILATION AND PRELIMINARY INTERPRETATION OF HYDROLOGIC DATA FOR THE WELDON SPRING RADIOACTIVE WASTE-DISPOSAL SITES, ST. CHARLES COUNTY, MISSOURI--A PROGRESS REPORT,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08680

THREE-DIMENSIONAL STEADY-STATE SIMULATION OF FLOW IN THE SAND-AND-GRAVEL AQUIFER, SOUTHERN ESCAMBIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. Trapp, and L. H. Geiger.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4278, 1986. 149p, 22 fig, 19 tab, 25 ref.

Descriptors: *Groundwater movement, *Aquifers, *Simulation analysis, *Model studies, *Hydrologic models, Geohydrology, Mathematical models, Groundwater mining, Transmissivity, Hydraulic conductivity, Groundwater recharge, Infiltration, Surface-groundwater relations, Groundwater level, Groundwater budget, Computer models.

The sand-and-gravel aquifer is the only freshwater aquifer in southern Escambia County, Florida and is the source of public water supply for the area, including the City of Pensacola. The aquifer was simulated by a two-layer, digital model to provide hydrologic information for water resource planning. The lower layer represents the main-producing zone; the upper layer represents all of the aquifer above the main-producing zone including an unconfined zone and discontinuous perched, confined, and confining zones. The model was designed for steady-state simulation and predicts the response of the aquifer (changes in water levels) to groundwater pumping where steady-state conditions have been reached. Input to the model includes matrices representing constant-head nodes, starting head, transmissivity of layer 1, leakance between layers 1 and 2, lateral hydraulic conductivity of layer 2, and altitude of the base layer 2. The sources of water to the model are from recharge by infiltrated precipitation (estimated from base runoff), inflow across boundaries, and induced recharge from river leakance in periods of prolonged groundwater pumping. Model output includes final head and drawdown for each layer and total values for discharge and recharge in the model area. The model was calibrated for 1972 pumping and tested by simulating pumpages during 1939-40, 1958, and 1977. Sensitivity analyses showed water levels in both layers were most sensitive to changes in the recharge matrix and least sensitive to river leakage. Suggestions for further development of the model include subdivision and expansion of the grid, assignment of storage coefficients for transient simulations, more intensive study of the stream-aquifer relations, and consideration of the effects of infiltration basins on recharge. (Author's abstract)
W89-08681

TWO-CONSTITUENT SOLUTE-TRANSPORT MODEL FOR GROUND WATER HAVING VARIABLE DENSITY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08682

GROUND-WATER YIELD AND POTENTIAL FOR IRRIGATED AGRICULTURE IN THE AREA OF THE NAVAL MAGAZINE AND RADIO TRANSMITTING FACILITY, LUALUALEI, OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
P. J. Shade, and K. J. Takasaki.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4280, 1986. 30p, 6 fig, 1 tab, 17 ref.

Descriptors: *Impaired water use, *Brackish water, *Groundwater mining, *Groundwater irrigation, *Groundwater movement, *Hawaii, Oahu, Aquifers, Volcanoes, Coralline Aquifer, Chlorides, Groundwater quality, Agricultural hydrology.

An estimated additional 2 million gallons per day (mgd) of fresh and slightly brackish water can be developed in Lualualei Valley, Hawaii, for the agricultural outleasing project. Several of these wells could be located in the volcanic aquifer which presently produces water of excellent quality. A secondary line of wells designed to develop water from the Coralline aquifer would capture the flow not captured by the wells in the volcanic aquifer. The chloride concentration of the water pumped from these wells is expected to range between 500 and 1,500 mg/L. The amount of acreage devoted to crops would depend primarily on the water quality and quantity requirements of the type of crops cultivated and on the type of irrigation system employed. The remaining acreage could be allocated for pasture to graze beef cattle. (Author's abstract)
W89-08683

HYDROGEOLOGY OF THE SOUTHWESTERN PART OF THE TOWN OF HEMPSTEAD, NASSAU COUNTY, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
R. K. Krulikas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4288, 1987. 16p, 3 fig, 3 tab, 6 plates, 21 ref.

Descriptors: *Geohydrology, *Groundwater budget, *Hempstead, *New York, Aquifers, Groundwater recharge, Precipitation, Water table, Groundwater level, Potentiometric level, Drought, Maps.

The groundwater reservoir underlying the area consists of deposits of unconsolidated gravel, sand, silt, and clay of Holocene, Pleistocene, and Late Cretaceous age that have been divided into eight geologic units. The maximum total thickness of the unconsolidated deposits is about 1,500 ft. Precipitation is the sole source of ground-water recharge in the area. The long-term average annual precipitation during 1927-83 was 42.62 in., as recorded at the Valley Stream weather station. The water table altitude in the area in the mid-1980's had recovered to levels that equaled or exceeded those before the regional drought of 1962-66. In contrast, the potentiometric surfaces in the Magothy and Lloyd aquifers were still somewhat below those before the drought but were recovering throughout most of the area as of 1985. The report presents 10 maps showing altitudes of the tops of the geologic units and the potentiometric surfaces of the three major aquifers. Also included are six geologic sections, four hydrographs, and several graphs presenting the data that were collected. (Author's abstract)
W89-08685

WATER-LEVEL DECLINES IN THE AMARGOSA VALLEY AREA, NYE COUNTY, NEVADA, 1962-84,
Geological Survey, Carson City, NV. Water Resources Div.
W. D. Nichols, and J. P. Akers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4273, 1985. 7p, 1 fig, 1 tab, 1 plates, 5 ref.

Descriptors: *Nevada, *Groundwater level, *Groundwater depletion, *Amargosa Valley, Water level, Wells.

Groundwater flow in the Amargosa Valley area is in Nevada complex and involves a valley fill aquifer and an underlying carbonate rock aquifer. Groundwater development in the area is in the valley fill aquifer, about 10 mi. south-west of Lathrop Wells. Water levels measured in selected wells in the area in 1984 are lower than those measured in 1962, demonstrating that water levels have undergone a net decline since 1962. An implied water level rise and resulting groundwater mound suggested on a map from a U.S. Bureau of Reclamation report appear to be based on the inadvertent misplotting of two wells. Data presented in this report indicate that the implied mound does not exist. (Lantz-PTT)
W89-08688

PRELIMINARY EVALUATION OF THE BASAL SANDSTONE IN TENNESSEE FOR RECEIVING INJECTED WASTES,
Geological Survey, Nashville, TN. Water Resources Div.
D. Mulderink, and M. W. Bradley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4303, 1986. 9p, 2 fig, 3 tab, 6 ref.

Descriptors: *Waste disposal, *Groundwater quality, *Water quality control, *Injection wells, *Tennessee, Deep wells, Permeability, Dissolved solids, Geohydrology, Drinking water, Sandstone.

The EPA is authorized, under the Safe Drinking Water Act, to administer the Underground Injection Control program. This program allows for the regulation of deep-well disposal of wastes and establishes criteria to protect underground sources of drinking water from contamination. The basal sandstone in Tennessee occurs west of the Valley and Ridge province at depths of 5,000 to 9,000 ft below land surface. The basal sandstone consists of about 30 to 750 ft of Cambrian sandstone overlying the crystalline basement complex. The basal sandstone is overlain and confined by shale and carbonate rocks of the Middle and Upper Cambrian Conasauga Group. Hydrologic data for the basal sandstone, available from only three sites (four wells) in Tennessee, indicate that the basal sandstone generally has low porosity and permeability with a few zones having enough permeability to accept injected fluids. Limited water quality data indicate the basal sandstone contains water with dissolved solids concentrations exceeding 10,000 mg/L. Since the dissolved-solids concentrations exceed 10,000 mg/L, the basal sandstone is not classified as an underground source of drinking water according to EPA regulations. (Author's abstract)
W89-08690

SIMULATION OF GROUND-WATER FLOW NEAR THE NUCLEAR-FUEL REPROCESSING FACILITY AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
R. M. Yager.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4308, 1987. 58p, 30 fig, 7 tab, 19 ref, 1 plate, append.

Descriptors: *Groundwater movement, *Simulation analysis, *Hydrologic models, *Nuclear powerplants, *Path of pollutants, Flow profiles, Model studies, Cattaraugus County, New York, Tritium, Geohydrology, Groundwater recharge, Evapotranspiration, Hydraulic conductivity.

A two-dimensional finite-difference model was developed to simulate groundwater flow in a surficial sand and gravel deposit underlying the nuclear fuel reprocessing facility at Western New York Nuclear Service Center near West Valley, N.Y. The sand and gravel deposit overlies a till plateau that abuts an upland area of siltstone and shale on its west side, and is bounded on the other three sides by deeply incised stream channels that drain to Buttermilk Creek, a tributary to Cattaraugus Creek. Radioactive materials are stored within the reprocessing plant and are also buried within a till deposit at the facility. Tritiated water is stored in a lagoon system near the plant and released under permit to Franks Creek, a tributary to Buttermilk Creek. Groundwater levels predicted by steady-state simulations closely matched those measured in 23 observation wells, with an average error of 0.5 meter. Simulated groundwater discharges to two stream channels and a subsurface drain were within 5% of recorded values. Steady-state simulations used an average annual recharge rate of 46 cm/yr; predicted evapotranspiration loss from the ground was 20 cm/yr. The lateral range in hydraulic conductivity obtained through model calibration was 0.6 to 10 m/day. Model simulations indicated that 33% of the groundwater discharged from the sand and gravel unit (2.6 L/sec) is lost by evapotranspiration, 3% (3.0 L/sec) flows to seepage faces at the periphery of the plateau, 20% (1.6 L/sec) discharges to stream channels that drain a large wetland area near the center of the plateau, and the remaining 8% (0.6 L/sec) discharges to a subsurface french drain and to a wastewater treatment system. Groundwater levels computed by a transient-state simulation of an annual climatic cycle, including seasonal variation in recharge and evapotranspiration, closely matched water levels measured in eight observation wells. The model predicted that the subsurface drain and the stream channel that drains the wetland would intercept most of the recharge originating near the reprocessing plant. (Lantz-PTT)
W89-08692

HYDROLOGY OF THE LEEWARD AQUIFERS, SOUTHEAST OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
P. Eyre, C. Ewart, and P. Shade.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4270, 1986. 75p, 25 fig, 5 tab, 35 ref.

Descriptors: *Water resources data, *Groundwater potential, *Aquifers, *Oahu, *Groundwater budget, Hydrologic regime, Groundwater movement, Waialae Aquifer, Wailupe-Hawaii Kai Aquifer, Groundwater movement, Leakage, Groundwater recharge, Model studies, Hydrologic models, Water table.

The leeward southeast Oahu groundwater area includes the Waialae and Wailupe-Hawaii Kai aquifers. The Waialae aquifer is separated from the groundwater of Kaimuki to the west by Palolo valley fill and the Kaau rift zone, and from the Wailupe-Hawaii Kai aquifer to the east by a line of northeast-trending volcanic dikes. The distinct groundwater head changes across these boundaries indicate that the aquifers are separate, with little or no leakage between them. A water budget of leeward southeast Oahu determined the quantity and spatial distribution of groundwater recharge. These estimates of recharge, 6 million gallons/day (mgd) over the Waialae area and 9.1 mgd over the Wailupe-Hawaii Kai area, were used as input to a finite element two-dimensional groundwater flow model. Groundwater heads were simulated in the modeled aquifer for several pumping scenarios. Projected pumpage from the recently drilled wells in the area is predicted to draw the water table down about one foot from its present mean position. The existing groundwater development of 1.4 mgd is small compared to the quantity of groundwater that flows through the area and discharges to the sea. Because the Waialae and Wailupe-Hawaii Kai aquifers are isolated from adjacent groundwater bodies, they can be fully developed without affecting groundwater resources outside the area. (Author's abstract)
W89-08694

EPA GROUND WATER HANDBOOK.
Government Institutes, Inc., Rockville, MD 20850. January 1989. 212p, 139 fig, 30 tab, 346 ref, 4 append.

Descriptors: *Groundwater quality, *Water quality control, *Groundwater management, Groundwater recharge, Discharge, Groundwater pollution, Research priorities, Information exchange, Geohydrology, Aquifers.

The impact of natural groundwater recharge and discharge processes on distributions of chemical constituents is understood for only a few types of chemical species. Also, these processes may be modified by both natural phenomena and man's activities so as to further complicate apparent spatial or temporal trends in water quality. Since so many climatic, demographic and geohydrologic factors may vary from place to place, or even small areas within specific sites, there can be no single 'standard' approach for assessing and protecting the quality of groundwater that will be applicable in all cases. Despite these uncertainties, investigations are under way and they are used as a basis for making decisions about the need for, and usefulness of, alternative corrective and preventive actions. Decision makers, therefore, need some assurance that elements of uncertainty are minimized and that geohydrologic investigations provide reliable results. A purpose of this document is to discuss measures that can be taken to ensure that uncertainties do not undermine the ability to make reliable predictions about the response of contamination to various corrective or preventive measures. EPA conducts considerable research in groundwater to support its regulatory needs. In recent years, scientific knowledge about groundwater systems has been increasing rapidly. Researchers in the Office of Research and Development have made improvements in technology for assessing the subsurface, in adapting techniques from other disciplines to successfully identify specific contaminants in groundwater, in assessing the behavior of certain chemicals in some geologic materials and in advancing the state-of-the-art of remedial technologies. An important part of EPA's groundwater research program is to transmit research information to decision makers, field managers and the scientific community. This publication has been developed to assist that effort and, additionally, to help satisfy an immediate Agency need to promote the transfer of technology that is applicable to groundwater contamination control and prevention. The information contained in this handbook is intended to meet that need. It is applicable to many programs that deal with the groundwater resource. However, it is not intended as a guidance or support document for a specific regulatory program. (Lantz-PTT)
W89-08695

SUPERFUND RECORD OF DECISION: MONTGOMERY TOWNSHIP, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08696

AQUIFER MODEL OF THE SUSQUEHANNA RIVER VALLEY IN SOUTHWESTERN BROOME COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
A. D. Randall.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4099, 1986. 38p, 8 fig, 3 tab, 4 pl, 30 ref.

Descriptors: *Groundwater movement, *Aquifers, *Hydrologic models, *Susquehanna River, *Model studies, *New York, Finite difference methods, Permeability, Outwash, Geohydrology, Glacial aquifers, Model studies, Hydraulic conductivity, Flow profiles, Groundwater level, Groundwater recharge.

A finite-difference model of groundwater flow within stratified drift in the 14 mi reach of the Susquehanna River valley from Binghamton west to Tioga County line (including Johnson City, Endicott, and Vestal) has been developed. Outwash is the most permeable and extensive type of stratified drift in the valley but has only small saturated thickness except where it is downwarped beneath ice-block depressions. The outwash is commonly underlain by extensive beds of silt and clay deposited in proglacial lakes. Older ice-contact deposits are also extensive and provide the largest yields to wells but are highly variable in thickness and commonly siltier than the outwash. The ice-contact deposits seem to occur mainly as ridges that parallel the axis of major valleys and are buried beneath later lacustrine and outwash sediments. The model simulates horizontal flow in two layers-the upper layer generally represents outwash, the lower layer generally represents older ice-contact deposits; and vertical flow between those layers through the beds of silt and clay or, where the two aquifer layers are in direct contact, through sand and gravel. The model has been calibrated to reproduce observed water levels that represent steady-state conditions. The model was calibrated for average steady-state conditions from data for April 1981, when water levels remained fairly stable for nearly 2 months. Recharge from precipitation on the aquifer during this period was determined to be about 1.28 in/mo. Transmissivity of the lower aquifer, as determined by calibration of the model for areas influenced by pumping, was significantly less than transmissivity values calculated from pumping records or geologic logs of individual wells. This difference is attributed to scattered silty layers that reduce average transmissivity of generally permeable materials. Data are available for transient calibration, including: (1) semiannual water level measurements that reflect seasonal changes in river stage, pumping, and recharge; (2) short-term pumping tests at several sites; and (3) measurements in the Clinton Street-Ballpark aquifer before 1967, when pumpage was 30% greater than in 1981. Transient calibration would improve the accuracy and predictive capability of the model. (Lantz-PTT)
W89-08717

SYNOPSIS OF SALTWATER INTRUSION IN DADE COUNTY, FLORIDA, THROUGH 1984,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. Klein, and B. G. Waller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4101, 1985. 1p, 8 fig, 12 ref.

Descriptors: *Saline water intrusion, *Dade County, *Ecological effects, Florida, Groundwater quality, Salt water, Biscayne Aquifer, Permeability, Land use, Water resources development.

The investigation of saltwater intrusion in Dade County by the U.S. Geological Survey began in the late 1930's and continues in cooperation with Dade County, the Miami-Dade Water and Sewer Authority, the South Florida Water Management District, the Florida Keys Aqueduct Authority, and the Homestead Air Force Base. It is through this continuing long-term study of the extent and causes of saltwater movement that assessments can be made of methods and criteria for controlling saltwater intrusion in the highly permeable Biscayne aquifer in Dade County--the sole source of drinking water for the area. This report summarizes the effects that major hydrologic changes--brought about by land reclamation, flood control, and water management by local and regional agencies--have had on saltwater intrusion in Dade County over the years and to delineate the extent of intrusion as of 1984. Saltwater intrusion is particularly dynamic in coastal Dade County because of the high permeability of the limestone composing the Biscayne aquifer, because of the good interconnection between canals and the aquifer, and because of the seasonal and year-to-year variability of rainfall. The problem is accentuated because urban growth continues to encroach on inland wetland areas which results in lowered

inland water levels. This lowering reduces the seaward freshwater hydraulic gradient and the freshwater head at the coast, both of which govern the intrusion of saltwater. (Lantz-PTT)
W89-08718

GROUND-WATER MOVEMENT AND EFFECTS OF COAL STRIP MINING ON WATER QUALITY OF HIGH-WALL LAKES AND AQUIFERS IN THE MACON-HUNTSVILLE AREA, NORTH-CENTRAL MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
D. C. Hall, and R. E. Davis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4102, 1986. 102p, 19 fig, 25 tab, 23 ref.

Descriptors: *Groundwater movement, *Coal mining, *Ecological effects, *Water pollution sources, *Groundwater quality, Lakes, Aquifers, Missouri, Geohydrology, Porosity, Groundwater recharge, Magnesium, Manganese, Sulfates, Chlorides, Hydrogen ion concentration, Calcium.

Glacial drift and Pennsylvanian bedrock were mixed together forming spoil during pre-reclamation strip mining for coal in north-central Missouri. This restructuring of the land increases the porosity of the material, and increases aqueous concentrations of many dissolved constituents. Median sodium and bicarbonate concentrations were slightly greater, calcium 5 times greater, magnesium 6 times greater, manganese 15 times greater, iron 19 times greater, and sulfate 24 times greater in water from spoil than in water from glacial drift. Median potassium concentrations were slightly greater, and chloride concentrations were two times greater in water from glacial drift than in water from spoil. Water types in glacial drift and bedrock were mostly sodium bicarbonate and calcium bicarbonate; in spoil and lakes in the spoil, the water types were mostly calcium sulfate. Median pH values in water from spoil were 6.6, as compared to 7.4 in water from glacial drift and 9.0 in water from bedrock. Neutralization of acid by carbonate rocks causes the moderate pH values in water from spoil; a carbonate system closed to the atmosphere may result in alkaline pH values in bedrock. Transmissivities generally are greatest for spoil, and decrease in the following order: alluvium, glacial drift, and bedrock. Recharge to spoil is from precipitation, lateral flow from glacial drift, and lateral and vertical flow from bedrock. The rate of recharge to the aquifers is unknown, but probably is small. Groundwater discharge from the glacial drift, bedrock, and spoil is to alluvium. The direction of flow generally was from high-wall lakes in the spoil toward East Fork Little Chariton River or South Fork Claybank Creek. Significant differences (95% confidence level) in values and concentrations of aqueous constituents between spoil areas mined at different times (1940, 1952, and 1968) were obtained for pH, calcium, magnesium, manganese, sulfate, chloride, and dissolved solids, but not for iron. These differences are attributed to local variations in the geohydrologic system rather than spoil age. (Lantz-PTT)
W89-08719

IDENTIFICATION AND DESCRIPTION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08722

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, APALACHICOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08723

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, DAYTONA BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08724

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, FORT PIERCE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08725

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, GAINESVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08726

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS JACKSONVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08727

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, KEY WEST 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08728

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, MIAMI 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08729

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, ORLANDO 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08730

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, PENSACOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08731

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TALLAHASSEE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08732

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TAMPA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08733

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TARPON SPRINGS 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08734

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, VALDOSTA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08735

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, WEST PALM BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08736

HYDROGEOLOGY OF THE OLEAN AREA, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
P. J. Zarriello, and R. J. Reynolds.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4157, 1987. 9p, 8 maps, 40 ref.

Descriptors: *Groundwater resources, Maps, *Olean, *New York, Test wells, Geohydrology, Bedrock, Topography, Potentiometric level, Aquifer characteristics, Soil porosity, Land use, Well yields.

Most principal aquifers in upstate New York are unconsolidated glacial and alluvial deposits within bedrock valleys. Groundwater in these aquifers can be under either water table (unconfined) or artesian (confined) conditions. Farms, industries, or towns and cities have been built upon many of these aquifers because they form level areas suitable for development and generally provide an ample groundwater supply. This development, coupled with the generally high permeability of these deposits and the typically shallow depth to the water table, makes groundwater in these aquifers susceptible to contamination from point sources such as landfills, road salt stockpiles, hydrocarbon fuel storage, and industrial facilities with a potential for contaminant leakage, in addition to urban and agricultural runoff, septic tank leachate, and other nonpoint sources. The report summarizes the geohydrology of the aquifer system in the Olean area. The large amount of geohydrologic data collected in the Olean area during previous and current investigations enabled the construction of nine maps: location and wells and test holes (plate 1), surficial geology (plate 2), geologic sections (plate 3), generalized bedrock topography (plate 4), potentiometric surface (plate 5), saturated thickness of the outwash aquifer (plate 6), generalized soil permeability (plate 7), land use (plate 8), and estimated well yields (plate 9). (Lantz-PTT)
W89-08737

GEOHYDROLOGY OF THE LLOYD AQUIFER, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
M. Garber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4159, 1986. 36p, 18 fig, 1 tab, 55 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *Groundwater budget, *New York, Lloyd Aquifer, Long Island, Potable water, Groundwater level, Transmissivity, Groundwater recharge, Groundwater depletion, Groundwater pollution, Potentiometric level, Saline water intrusion, Coastal aquifers.

The Lloyd aquifer contains only about 9% of the water stored in Long Island's groundwater system but is the only source of potable water for several communities near the north and south shores. The Lloyd aquifer is virtually untapped throughout most of central Long Island because current legal restrictions permit its use only in coastal areas. The upper surface of the Lloyd aquifer ranges in depth from 100 ft below land surface on the north shore to more than 1,500 ft on the south shore. Aquifer thickness increases southward from 50 ft to about 500 ft. Transmissivity ranges from 1,500 to 19,000 sq ft/day. All recharge (35 to 40 mil gal/day) and nearly all discharge is through the overlying confining unit. Nearly all of the pumpage (approximately 20 mil gal/day) is in Queens and along the north and south shores of Nassau County. Potable water can be obtained on most of Long Island in larger quantities and at shallower depths from

other aquifers than from the Lloyd. Local contamination of these other aquifers, however, may require at least temporary withdrawals from the Lloyd in noncoastal areas. Significant withdrawals from the Lloyd aquifer may lower the potentiometric surface and thereby induce landward movement of sea water into the aquifer in coastal areas. (Author's abstract)
W89-08739

WATER RESOURCES OF THE LOWER RIO GRANDE DE ARECIBO ALLUVIAL VALLEY, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08740

SURFICIAL AQUIFER SYSTEM IN EASTERN LEE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. H. Boggess, and F. A. Watkins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4161, 1986. 59p, 17 fig, 7 tab, 20 ref.

Descriptors: *Aquifer systems, *Groundwater budget, *Florida, Wells, Groundwater level, Groundwater recharge, Leaching, Groundwater movement, Chlorides, Dissolved solids, Transmissivity, Confined aquifers, Storage.

The surficial aquifer system in eastern Lee County consists of an upper water bearing unit, which is generally unconfined, and a lower water bearing unit, which is confined and is the major source tapped by most wells. The top of the lower unit, which is of primary interest in this report, ranges in depth from 40 to 60 ft below land surface in the east-central part of the county to more than 120 ft in the southern part. In the extreme southern part of the county, a middle water bearing unit also contains water under artesian pressure. Recharge to the lower unit occurs primarily by leakage from the overlying saturated section through the confining beds. Water levels in the lower unit fluctuate similarly to those in the upper (unconfined) unit. Groundwater in the lower unit moves from areas of highest water level in the south part of Lehigh acres, northward toward the Caloosahatchee River, and toward the coast. The lower unit contains freshwater throughout much of its extent and is the source of public water supply at Lehigh Acres and Green Meadows where an average of about 3 mil gal/day was withdrawn in 1980. In several areas, the concentrations of chlorides and dissolved solids exceed drinking water standards. Yields of wells that tap the lower unit range from 10 to 1,100 gal/min. Transmissivities ranging from about 17,700 to 7,750 sq ft/day were determined for different areas of the unit. Storage coefficients range from 0.0001 to 0.0003. (Author's abstract)
W89-08741

HYDROLOGIC EFFECTS OF GROUND- AND SURFACE-WATER WITHDRAWALS IN THE HOWE AREA, LAGRANGE COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
Z. C. Bailey, T. K. Greeman, and E. J. Crompton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4163, 1985. 130p, 55 fig, 14 tab, 24 ref.

Descriptors: *Irrigation effects, *Selective withdrawal, *Environmental effects, *Groundwater depletion, *Geohydrology, *Indiana, *Surface-groundwater relations, Aquifers, Hydraulic properties, Groundwater irrigation, Hydraulic conductivity, Transmissivity, Groundwater budget, Simulation analysis, Drawdown.

Geometry and hydraulic characteristics of a 46.5 sq mi area of the sand and gravel outwash-aquifer system between Fawn and Pigeon Rivers in Lagrange County were defined in a study of the effect of current and potential uses of water on the aquifer, streams, lakes, and wetlands. There are three aquifers: Aquifer 1, a surficial water table aquifer that ranges from 10 to 60 ft in thickness, hydraulic conductivity of 210 ft/d, and transmissivity of 5,000 to 16,000 sq ft/day. Aquifer 2 ranges from 50 to 110 ft in thickness, hydraulic conductivity of 360 ft/d, and transmissivity ranges of 5,000 to 35,000 sq ft/day. Aquifer 3 ranges from zero to 200 ft in thickness, hydraulic conductivity of 25 ft/d, and transmissivity of zero to 5,000 sq ft/d. A three-layer digital flow model was calibrated to steady-state water levels during autumn 1982. The effects of current and potential development of irrigation on the groundwater and surface water systems were estimated by transient simulations of five pumping plans. The effect of year-round pumping was estimated by steady-state simulation of a sixth plan. Plan 1 was a simulation of current irrigational development with pumpage equal to that which supplied water to crops in 1982. Maximum simulated drawdowns were 4 ft in layer 1 and 14 ft in layers 2 and 3. Simulated drawdowns were greater than those observed in 1982. Plans 2 and 3 were simulations of the current irrigational development with pumping rates that would supply water to crops in a normal and in a dry year. The effect on the hydrologic system by pumping in plans 2 and 3, therefore, is minimal. Plans 4 and 5 were simulations of maximum potential irrigational development that would supply water to a corn crop during a normal and a dry year. The maximum simulated drawdowns for plan 4 were 14, 30, and 31 ft in aquifers 1, 2, and 3, respectively. Maximum drawdowns for plan 5 were 15, 32, and 31 ft in aquifers 1, 2 and 3. (Lantz-PTT)
W89-08742

CHEMICAL QUALITY OF GROUND WATER IN SACRAMENTO AND WESTERN PLACER COUNTIES, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
K. L. Johnson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4164, November 1985. 50p, 19 fig, 4 tab, 30 ref.

Descriptors: *Water chemistry, *Irrigation water, *Groundwater quality, *Chemical analysis, *California, *Water quality, Chemical properties, Sacramento County, Placer County, Wells, Sacramento River, Dissolved solids, Calcium, Magnesium, Bicarbonates, Salinity, Sodium.

Chemical quality of groundwater was investigated in Sacramento and western Placer Counties during the summer of 1982. Chemical analyses of water samples from 209 wells indicate that the groundwater is suitable for domestic and most agricultural uses. Water from wells near the Sacramento River and a few wells near Lincoln had high concentrations of dissolved solids and some trace elements. Although chemical water types varied, 53% of the wells had a combination of calcium magnesium bicarbonate water. More than 90% of the wells sampled had water with a low to medium sodium-salinity hazard when used for irrigation. (Author's abstract)
W89-08743

GEOHYDROLOGY AND GROUND-WATER QUALITY ON SHELTER ISLAND, SUFFOLK COUNTY, NEW YORK, 1983-84,
Geological Survey, Syosset, NY. Water Resources Div.
D. L. Simmons.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4165, 1986. 39p, 8 fig, 5 tab, 19 ref, 3 append.

Descriptors: *Water quality, *Geohydrology, *Saline water intrusion, *Groundwater quality, *New York, Saline-freshwater interface, Chlorides, Iron, Manganese, Dissolved solids, Drinking water, Upconing, Shelter Island.

Shelter Island, with an area of about 11 sq mi, lies between the north and south forks of eastern Long Island in Suffolk County. The thin upper glacial (water table) aquifer contains the lens-shaped freshwater body that is the sole source of freshwater for the Town's population of about 2,200 year-round and 10,000 summer residents. Chloride concentrations in groundwater above the freshwater/saltwater interface, defined as 40 mg/L Cl-, are relatively constant with depth. Below the interface, however, chloride concentrations increase rapidly--as much as an order of magnitude within 10 ft--until they reach 19,000 mg/L, the chloride concentration of seawater. Chloride concentrations in shallow groundwater from wells screened in or near the zone of diffusion may range over two orders of magnitude in response to variations in recharge and groundwater withdrawal. After the summer season of relatively low recharge and peak water demand, the thickness of the freshwater lens is < 20 ft in many nearshore areas. A map showing the configuration of the water table in December 1983 indicates freshwater mounds in the center of the island, in the Mashomack Preserve, on the Dering Harbor-Hay Beach peninsula, and in the area between Shelter Island Heights and West Neck Bay. Areas in which the supply of fresh groundwater is severely limited include all coastal areas, the southernmost part of the West Neck peninsula, and Little Ram Island. Water levels in most locations are < 6 ft above sea level. During 1974-83, seasonal water table fluctuations were greater than variations that occurred from year to year. Groundwater quality on Shelter Island is generally good and usually meets Federal and State drinking water standards. However, many wells contain water that has excessive concentrations of dissolved iron and manganese (up to 5.0 mg/L and 3.0 mg/L, respectively), and elevated chloride and dissolved solids concentrations (up to 310 mg/L and 585 mg/L, respectively) have been found in some nearshore wells. Increased withdrawal of fresh groundwater in nearshore areas will cause further landward movement of saline groundwater; in other areas, excessive pumping may cause upconing. A system of widely spaced pumping wells that avoid nearshore areas would minimize these effects. (Lantz-PTT)
W89-08744

HYDROLOGIC EFFECTS OF GROUND- AND SURFACE-WATER WITHDRAWALS IN THE MILFORD AREA, ELKHART AND KOSCIUSKO COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08745

DOCUMENTATION OF A REGIONAL AQUIFER SIMULATION MODEL, RAQSIM, AND A DESCRIPTION OF SUPPORT PROGRAMS APPLIED IN THE TWIN PLATTE-MIDDLE REPUBLICAN STUDY AREA, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
R. E. Cady, and J. M. Peckenpaugh.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4168, 1985. 239p, 17 fig, 2 tab, 16 ref.

Descriptors: *Hydrologic models, *Aquifers, *Simulation analysis, *Model studies, RAQSIM, Groundwater movement, Nebraska, Flow profiles, Finite element method, Computer programs, Mathematical models, Evapotranspiration, Soil water, Groundwater recharge, Flow discharge.

RAQSIM, a generalized flow model of a groundwater system using finite-element methods, is documented to explain how it works and to demonstrate that it gives valid results. Three support programs that are used to compute recharge and discharge data required as input to RAQSIM are described. RAQSIM was developed to solve transient, two-dimensional, regional groundwater flow problems with isotropic or anisotropic conductance. The model can also simulate radially-symmetric flow to a well and steady-state flow. The mathematical basis, program structure, data input and output procedures, organization of data sets,

and program features and options of RAQSIM are discussed. An example, containing listings of data and results and illustrating RAQSIM's capabilities, is discussed in detail. Two test problems also are discussed comparing RAQSIM's results with analytical procedures. The first support program described, the PET Program, uses solar radiation and other climatic data in the Jensen-Haise method to compute potential evapotranspiration. The second support program, the Soil-Water Program, uses output from the PET Program, soil characteristics, and the ratio of potential to actual evapotranspiration for each crop to compute infiltration, storage, and removal of water from the soil zone. The third program, the Recharge-Discharge Program, uses output from the Soil-Water Program together with other data to compute recharge and discharge from the groundwater flow system. For each support program, a program listing and examples of the data and results for the Twin Platte-Middle Republican study are provided. In addition, a brief discussion on how each program operates and on procedures for running and modifying these programs are presented. (Author's abstract)
W89-08747

HYDROLOGIC FACTORS AFFECTING LAKE-LEVEL FLUCTUATIONS IN BIG MARINE LAKE, WASHINGTON COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08753

SHALLOW GROUND-WATER FLOW, WATER LEVELS, AND QUALITY OF WATER, 1980-84, COWLES UNIT, INDIANA DUNES NATIONAL LAKESHORE,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. A. Cohen, and R. J. Shedlock.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4340, January 1986. 25p, 10 fig, 1 tab, 11 ref.

Descriptors: *Industrial wastes, *Water pollution sources, *Groundwater quality, *Groundwater level, *Indiana, Dunes National Lakeshore, Aquifers, Monitoring, Groundwater recharge, Groundwater depletion, Wetlands, Boron, Cadmium, Arsenic, Zinc, Molybdenum, Groundwater pollution, Path of pollutants.

The Cowles Unit of Indiana Dunes National Lakeshore in Porter County, northwest Indiana, contains a broad dune-beach complex along the southern shoreline of Lake Michigan and a large wetland, called the Great Marsh, that occupies the lowland between the shoreline dunes and an older dune-beach complex farther inland. These lacustrine sediments form a surficial aquifer that extends from the Lake Michigan shoreline to the northern edge of the Lake Border moraine. Water levels and water quality in the surficial aquifer were monitored from 1977 to 1984 near settling ponds on adjacent industrial property at the western end of the Cowles Unit. Seepage from the settling ponds from 1967 to 1980 created a water table mound that extended north into the shoreline dune complex and caused perennial flooding of several intradunal lowlands on National Lakeshore property. Since 1980, when the settling pond bottoms were sealed, these intradunal lowlands contained standing water only during periods of high snowmelt or rainfall. Water level declines following the cessation of seepage ranged from 6 feet at the easternmost settling pond to nearly 14 feet at the westernmost pond. No general pattern of water table decline was observed in the Great Marsh or in the shoreline dune complex at distances > 3,000 ft east or north of the settling ponds. Since the settling ponds were sealed, the concentration of boron has decreased while concentrations of cadmium, arsenic, zinc, and molybdenum in shallow groundwater downgradient of the ponds show no definite trends in time. Arsenic, boron and molybdenum have remained at concentrations above those of shallow groundwater in areas unaffected by settling pond seepage. (Author's abstract)
W89-08754

GROUND-WATER FLOW AND SOLUTE TRANSPORT IN THE EQUUS BEDS AREA, SOUTH-CENTRAL KANSAS, 1940-79,
Geological Survey, Lawrence, KS. Water Resources Div.
J. M. Spinazola, J. B. Gillespie, and R. J. Hart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4336, 1985. 68p, 33 fig, 2 tab, 1 plate, 33 ref.

Descriptors: *Solute transport, *Groundwater movement, *Path of pollutants, *Surface-groundwater relations, *Model studies, *Equus Beds Aquifer, *Kansas, Chlorides, Groundwater pollution, Hydrologic models, Simulation analysis, Wellington aquifer, Geohydrology.

Water levels have declined about 30 ft from 1940 to 1980 in part of the Equus beds aquifer in south-central Kansas where the city of Wichita operates a well field. A three-dimensional, finite-difference, groundwater flow model was developed to: (1) Reproduce hydrologic conditions in the flow system between the Equus beds aquifer and the underlying Wellington aquifer from 1940 to 1980, and (2) simulate the effect that future withdrawals could have on water supply in the Equus beds aquifer and on relationships between water levels in the Equus beds aquifer and the Wellington aquifer from 1980 to 2020. The model favorably reproduced both measured water levels and streamflow gains in the Equus beds aquifer for 1971 and 1980, and measured water levels in the Wellington aquifer. The flow model then was used to simulate the effects of five pumping alternatives based on rates of withdrawal by wells from 1971-79. For the first alternative, withdrawal rates were decreased by one-half. Projected saturated thickness in the aquifer and streamflow gain were the greatest among the five alternatives. For the second alternative, withdrawal rates for 1971-79 were continued. Compared to results from the first alternative, saturated thickness was projected to decline from 10 to 40 ft in some areas, and streamflow gains were maintained for the Arkansas and Little Arkansas Rivers. A two-dimensional, finite-difference, solute-transport model was developed to: (1) Reproduce the movement of chloride ion in part of the Equus beds aquifer, including the Wichita municipal well field, from 1940 to 1980, and (2) simulate the effect that future withdrawal rates could have on the concentration of chloride ion from 1980 to 2020. Sources of the chloride ion were oilfield brine disposed from 1932-43 that is moving toward the well field and water in the Arkansas River. Each simulation projected an increase in the concentration of chloride ion in the Wichita well field. The projections indicated that a continuous 1,000 mg/L source of chloride ion in streamflow losses from the Arkansas River had a greater effect on increasing chloride-ion concentrations in the Wichita well field than did the movement of residual oilfield brine. (Author's abstract)
W89-08755

HYDROGEOLOGY OF SAND-PLAIN AQUIFERS IN CARLTON, KANABEC, AND PINE COUNTIES, EAST-CENTRAL MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
C. F. Myette.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4334, 1986. 66p, 23 fig, 8 tab, 4 plates, 41 ref.

Descriptors: *Geohydrology, *Aquifers, *Groundwater quality, *Minnesota, Transmissivity, Dissolved solids, Iron, Manganese, Groundwater movement, Groundwater discharge, Water resources development.

Sand-plain aquifers in parts of Carlton, Kanabec, and Pine Counties in east-central Minnesota constitute a major aquifer system. They consist predominantly of fine to medium outwash sand with a combined areal extent of nearly 500 sq mi. Saturated thickness in localized areas is as much as 90 ft. Depth to water generally is < 20 ft. Transmissivities range from about 100 to 25,000 sq ft/day. Yields to properly constructed wells locally may exceed 2,000 gal/min. A reconnaissance of sandstone units underlying the outwash indicates that transmissivities of the sandstone aquifers range from 1,850 to 2,200 sq ft/day, and specific capacities range from 9 to 12 gal/min/ft of drawdown. Locally, wells may be capable of supplying several hundred gal/min. Regionally, the sand-plain and sandstone aquifers are poorly connected hydraulically at all locations tested except in a small localized area near Quamba in Kanabec County. Groundwater in the sand-plain aquifers can be classified chemically, based on predominant ions, as a calcium bicarbonate type that is moderately hard. Concentrations of dissolved solids range from 30 to 610 mg/L. Except for locally high concentrations of iron and manganese, the quality of water is within State drinking water standards and is suitable for most uses. There are no major differences between the quality of water in the sand-plain and sandstone aquifers. Groundwater flow, aquifer response, aquifer development, and drought conditions were simulated for sand-plain aquifers areally extensive enough to be hydrologically significant. Simulation of expanded groundwater development and drought in northern Pine County indicates that regional groundwater levels may be lowered as much as 12 ft and groundwater discharge to streams may be reduced as much as 42%. Simulation of expanded development and drought in southern Pine County indicates that regional groundwater levels may be lowered as much as 25 ft and groundwater discharge to streams may be reduced as much as 65%. The simulations also indicate that each area, especially the northern Pine County area, will support substantial additional development without dewatering the aquifer or reducing streamflow significantly. (Author's abstract)
W89-08757

GROUND-WATER LEVELS IN THE COCKEYSVILLE MARBLE OF SOUTHERN CHESTER COUNTY, PENNSYLVANIA, 1983-84,
For primary bibliographic entry see Field 7C.
W89-08758

GROUND-WATER RESOURCES OF JONES COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
E. H. Boswell, D. Darden, and G. A. Bednar.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4342, 1987. 49p, 19 fig, 6 tab, 30 ref.

Descriptors: *Water resources, *Water use, *Groundwater budget, *Groundwater quality, *Mississippi, Jones County, Groundwater depletion, Hydraulic properties, Transmissivity, Iron, Color, Dissolved solids, Hydrogen ion concentration, Groundwater level.

Jones County, Mississippi, is supplied with groundwater from aquifers in strata of Eocene and younger age. The largest groundwater withdrawals are from aquifers in the Catahoula Sandstone of the Miocene aquifer system that occur at depths of 200 and 400 ft in the Laurel area. Several public and industrial water supply wells obtain water from deeper Eocene strata that occur at depths of more than 900 ft. Pumpage from all aquifers in Jones County for all uses increased from < 1 million gal/day (mgd) in 1925 to a maximum of 21.6 mgd in 1975. The city of Laurel used about 6.2 mgd in 1984 and total water use for the county was about 14.1 mgd. The extreme irregularity of the sand beds that form the aquifers is reflected in the wide range in hydraulic characteristics. Transmissivity values range from 600 to 10,000 sq ft/day and average about 6,000 sq ft/day. The average hydraulic conductivity is about 90 ft/day. Water levels in key observation wells in the lower Catahoula aquifer at Laurel have declined from about 150 ft above sea level in 1945 to about 80 ft above sea level in 1985. Since 1975, water levels in the

Catahoula aquifers in the Laurel area have declined at a slower rate, but the cone of depression has enlarged because of areal changes in pumping. Water in the major aquifers is usable for most purposes, and concentrations of common constituents do not exceed water quality criteria for drinking water supplies. Iron concentrations are highest in the Catahoula and Vicksburg aquifers, exceeding 0.30 mg/L in water from 33% of the wells for which data are available. Color is highest in the Eocene Cockfield aquifer, exceeding 50 units in water from 60% of the wells. Dissolved solids concentrations range from 487 to 840 mg/L in water from wells in the Cockfield and Sparta aquifers. The pH values generally are < 7.0 in water from wells in the Catahoula and Vicksburg aquifers and > 8.4 in water from wells in the Cockfield and Sparta aquifers. Hardness of water from all aquifers rarely exceeds 50 mg/L. (Lantz-PTT)
W89-08759

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-6A, H-6B, AND H-6C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
K. F. Dennehy.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-8, January 1982. 68p, 13 fig, 5 tab, 7 ref.

Descriptors: *Radioactive waste disposal, *New Mexico, *Path of pollutants, *Groundwater quality, *Pollutant identification, *Waste disposal, *Geohydrology, Transmissivity, Dissolved solids, Sulfates, Sodium, Chlorides, Radium.

Hydrologic testing was conducted at wells H-6A, H-6B, and H-6C in the northwestern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico to define hydraulic properties of three water-bearing zones. The zones tested were the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact. The Magenta Dolomite and the Rustler-Salado contact yield water to wells at rates < 0.5 gal/min as determined from shut-in and slug tests. A transmissivity value for the Culebra Dolomite Member was obtained by conducting conventional pumping and recovery tests. Well H-6B was pumped at a rate of approximately 11 gal/min. Throughout the testing of the Magenta Dolomite Member and the Rustler-Salado contact, water pressure response in the test zones was monitored by a pressure transducer system. The following calculated transmissivity (sq ft/day) and storage coefficient values were derived for the test zones: H-6A, Magenta Dolomite Member of the Rustler Formation, 0.3 sq ft/day and 0.00001; H-6B, Culebra Dolomite Member of the Rustler Formation, 78 sq ft/day and 0; H-6C Rustler Formation-Salado Formation contact, .003 sq ft/day and 00.00001. Water samples from the Magenta Dolomite Member of the Rustler Formation had a dissolved solids concentration of 5,760 mg/L. The major chemical constituents of water samples from this zone were sulfate, sodium, and chloride. Water samples from the Culebra Dolomite Member of the Rustler Formation had a dissolved solids concentration of 52,600 mg/L, and samples from the Rustler Formation-Salado Formation contact had 316,000 mg/L; chloride and sodium were the major constituents in the water samples. Radium-266, a naturally occurring radioactive element, was present in samples from all three zones. (Author's abstract)
W89-08762

GEOLOGY OF THE '20-FOOT' CLAY AND GARDINERS CLAY IN SOUTHERN NASSAU AND SOUTHWESTERN SUFFOLK COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
T. P. Doriski, and F. Wilde-Katz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-4056, 1983. 17p, 1 fig, 2 tab, 8 pl, 14 ref. EPA Grant C-36-10365-04.

Descriptors: *Geohydrology, *Long Island, *Hydrologic data collections, *New York, Maps, Groundwater budget, Geologic formations, Hydrologic maps.

Data from 1978-79 drilling was compiled with information from previous reports and historical records to prepare surface contour and isopach maps of the '20-foot' clay and Gardiners Clay in southern Nassau and southwestern Suffolk Counties. These units are major confining layers in the upper part of the groundwater reservoir along Long Island's south shore. Where present, they influence the groundwater flow patterns locally. The '20-foot' clay, previously mapped in Nassau County only, was found in test borings in Suffolk County also. Its surface altitude ranges from 20 to 40 ft below NGVD (National Geodetic Vertical Datum of 1929); thickness ranges from 0 to 30 ft. The surface altitude of the Gardiners Clay ranges from 40 to 120 ft below NGVD; thickness ranges from 0 to 90 ft. Previously known discontinuities in both formations are more accurately delineated, and several new discontinuities have been inferred from the new data. The Matawan Group-Magothy Formation undifferentiated the Monmouth Group, and the Jameco Gravel directly underlie the Gardiners Clay. Revised surface altitudes of these formations are depicted on maps and cross sections of the south-shore area. (Author's abstract)
W89-08763

HYDROLOGIC MAPS OF THE HIGH PLAINS AQUIFER, JANUARY 1981, SOUTHWESTERN KANSAS,
For primary bibliographic entry see Field 7C.
W89-08764

EFFECTS OF LAND USE ON GROUNDWATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08766

ESTIMATED USE OF GROUND WATER FOR IRRIGATION IN WISCONSIN, 1984,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08769

WATER LEVEL AND SATURATED THICKNESS MAPS OF THE ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1984,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08771

POTENTIOMETRIC MAP OF THE MERIDIAN-UPPER WILCOX AQUIFER IN MISSISSIPPI, FALL 1983,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08773

HYDRAULIC PROPERTIES OF ROCK UNITS AND CHEMICAL QUALITY OF WATER FOR INEL-1--A 10,365-FOOT DEEP TEST HOLE DRILLED AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. J. Mann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4020, February 1986. 23p, 8 fig, 2 tab, 8 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Water chemistry, *Groundwater, *Hydraulic properties, *Water quality, *Idaho, Chemical properties, Hydraulic conductivity, Snake River, Water temperature, Dissolved solids, Aquifers, Sodium bicarbonate.

A 10,365-ft deep test hole drilled at the INEL (Idaho National Engineering Laboratory) in southeastern Idaho provided hydraulic information for rock units underlying the Snake River Plain aquifer. Four aquifer tests showed that the hydraulic conductivity decreased with depth--from an average of 0.03 ft/day for the interval from 1,511 to 2,206 ft below land surface to an average of 0.002 ft/day for the interval from 4,210 to 10,365 ft. In contrast the hydraulic conductivity of the Snake River Plain aquifer ranges from 1 to 100 ft/day. The hydraulic head increased with depth; the head at depth was about 115 ft greater than that for the Snake River Plain aquifer. Water temperature in the test hole increased from 26 C at 600 ft below land surface to 146 C at 9,985 ft. The gradient was nearly linear and averaged about 1.3 C/100 ft of depth. Water from the Snake River Plain aquifer contained 381 mg/L of dissolved solids and had a calcium bicarbonate chemical composition. The dissolved solids concentration in underlying rock units ranged from 350 to 1,020 mg/L and the water had a sodium bicarbonate composition. Hydrologic data for the test hole suggest that the effective base of the Snake River Plain aquifer near the test hole is between 840 and 1,220 ft below land surface. The upward vertical movement of water into the Snake River Plain aquifer from underlying rock units could be on the order of 15,000 acre-ft/year at INEL. (Author's abstract)
W89-08775

WATER LEVELS IN MAJOR ARTESIAN AQUIFERS OF THE NEW JERSEY COASTAL PLAIN, 1983,
Geological Survey, Trenton, NJ. Water Resources Div.
J. A. Eckel, and R. L. Walker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4028, 1986. 62p, 12 fig, 10 tab, 7 plates, 32 ref.

Descriptors: *Groundwater level, *Hydrologic maps, *Coastal aquifers, *Confined aquifers, *New Jersey, *Water level, Groundwater depletion, Potentiometric level, Hydrographs, Maps.

Water levels and changes in water levels in the major aquifers of the New Jersey Coastal Plain are documented. Water levels in 1,071 wells were measured in 1983, and are compared with 827 water level measurements made in the same wells in 1978. Increased groundwater withdrawals from the major artesian aquifers that underlie the New Jersey Coastal Plain have caused large cones of depression in the artesian heads. These cones are delineated on detailed potentiometric surface maps based on water level data collected in the fall of 1983. Hydrographs from observation wells show trends of water levels for the 6-year period of 1978 through 1983. The Potomac-Raritan-Magothy aquifer system is divided into the lower, middle, and upper aquifers. The potentiometric surfaces in these aquifers form large cones of depression centered in the Camden and Middlesex-Monmouth County areas. Measured water levels declined as much as 23 ft in these areas for the period of study. The lowest levels are 96 ft below sea level in Camden County and 91 ft below sea level in the Middlesex-Monmouth County area. Deep cones of depression in coastal Monmouth and Ocean counties in both the Englishtown aquifer system and Wenonah-Mount Laurel aquifer are similar in location and shape. This is because of an effective hydraulic connection between these aquifers. Measured water levels declined as much as 29 ft in the Englishtown aquifer system and 21 ft in the Wenonah-Mount Laurel aquifer during the period of study. The lowest levels are 249 ft below sea level in the Englishtown aquifer system and 196 ft below sea level in the Wenonah-Mount Laurel aquifer. Water levels in the Piney Point aquifer are as low as 75 ft below sea level at Seaside Park, Ocean County and 35 ft below sea level in southern Cumberland County. Water levels in Cumber-

land County are affected by large withdrawals of groundwater in Kent County, Delaware. Water levels in the Atlantic City 800 ft sand of the Kirkwood Formation define an extensive elongated cone of depression. Water levels are as low as 76 ft below sea level near Margate and Ventnor, Atlantic County. Measured water levels declined as much as 9 ft in the coastal region between Cape May County and Ocean County for the period of study. (Author's abstract)
W89-08779

POTENTIAL FOR UPDIP MOVEMENT OF SALINEWATER IN THE EDWARDS AQUIFER, SAN ANTONIO, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
R. Perez.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4032, 1986. 21p, 6 fig, 2 tab, 5 ref.

Descriptors: *Texas, *Confined aquifers, *Edwards Aquifer, *Saline water intrusion, *Model studies, *Groundwater movement, *Hydrologic models, Dissolved solids, Aquifers, Salt water, Salinity, Mathematical models, Simulation analysis, Transmissivity, Porosity, Groundwater level.

The salinity front, locally known as the 'bad-water' line, in the Edwards aquifer separates the freshwater from the saline water and occurs where the aquifer is confined. The concentration of dissolved solids of the saline water at the salinity front is 1,000 mg/L. The concentration of dissolved solids in water within the freshwater zone of the aquifer usually ranges from 250 to 350 mg/L. A digital model was used to investigate the potential movement of the salinity front by simulating the transport of saline water into the freshwater zone as a result of pumping from the freshwater zone. The model simulations indicate that a large range in the quantity of solute transported form the saline water zone into the freshwater zone is possible. This uncertainty is caused by the range of estimates of transmissivity, the magnitude of water level decline, and porosity. Simulated transmissivity values for the Edwards aquifer within the saline water zone ranged from 134 to 3,340 sq ft/day and resulted in potential lateral shifts of the salinity front from 16 to 425 feet updip into the freshwater zone at the end of the 10-yr simulation. A simulated decline in water levels from an altitude of 660 to 582 ft above sea level resulted in a potential lateral shift in the salinity front of 133 ft updip into the freshwater zone at the end of the 10-yr simulation. Simulated porosity values from 1% to 20% resulted in lateral shifts of the salinity front from 42 ft to 854 ft updip into the freshwater zone at the end of the 10-yr simulation. An evaluation of the results of the model simulations indicate that contamination created by the movement of saline water into the freshwater zone of the Edwards aquifer will be limited to an area within 0.2 mile of the present salinity front under the tested conditions. (Author's abstract)
W89-08782

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF CRYSTALLINE-ROCK AQUIFERS OF ARCHEAN AND PROTEROZOIC AGE, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08783

WATER RESOURCES OF MINER COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
N. C. Koch, and S. D. McGarvie.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4035, 1988. 37p, 18 fig, 4 tab, 17 ref.

Descriptors: *Streamflow, *Water quality, *Aquifer characteristics, *Water resources, *Groundwater potential, *Groundwater budget, *Aquifers, *South Dakota, Miner County, Geohydrology, Groundwater level, Groundwater quality, Geologic fractures, Groundwater irrigation.

Miner County is a rural agricultural area of 572 sq mi in east-central South Dakota. All streams in the county are intermittent and usually are recharged only from spring snowmelt and precipitation. Most ponds and sloughs may go dry in summer and during drought conditions, while larger lakes and ponds will contain water year round. Three major confined glacial aquifers underlie Miner County. The Floyd aquifer, buried beneath 25-150 ft of glacial drift, ranges from 10-100 ft in thickness. Water levels in the Floyd range from flowing to 56 ft below land surface. Properly constructed wells in the aquifer may produce as much as 1,200 gal/min. The Floyd aquifer offers the greatest potential for irrigation or other large yield development. Predominant chemical constituents in water from the Floyd aquifer are sodium, calcium and sulfate; however, there is a wide variation in the chemical composition of the water. For the most part it is suitable for irrigation. The Howard aquifer, is buried beneath 80-350 ft of glacial drift and ranges from 4-170 ft in thickness. Water levels in the Howard aquifer range from 16-200 ft below land surface. The Ramona aquifer underlies about 70 sq mi and is buried beneath 25-170 ft of glacial drift and ranges from 4-32 ft in thickness. Water levels in the Ramona range from 10-105 ft below land surface. Four bedrock aquifers underlie Miner County. The uppermost aquifer is the Niobrara Formation, buried by 60-600 ft of Pierre Shale and/or glacial drift with a thickness ranging from 10-120 ft. Water levels in the aquifer range from 6 ft above land surface to 200 ft below land surface. The Codell Sandstone Member of the Carlile Shale which underlies the Niobrara Formation is at depths ranging from 120-720 ft below land surface. It ranges from 10-120 ft in thickness. Water levels in the Codell aquifer range from flowing at land surface to 235 ft below land surface. Water from the aquifer generally is not suitable for irrigation. The Dakota Formation is buried by 400-1,000 ft of bedrock and glacial drift and is separated from the Codell aquifer by overlying carbonate rock and shale. The Dakota aquifer ranges from 10-400 ft in thickness. Water levels in the aquifer range from 25 ft above land surface to 260 ft below land surface. Water from the aquifer generally is not suitable for irrigation. (Lantz-PTT)
W89-08785

HYDROLOGY AND WATER QUALITY OF THE EDWARDS AQUIFER ASSOCIATED WITH BARTON SPRINGS IN THE AUSTIN AREA, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
R. M. Slade, M. E. Dorsey, and S. L. Stewart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4036, 1986. 117p, 44 fig, 9 tab, 64 ref.

Descriptors: *Aquifer characteristics, *Karst hydrology, *Groundwater quality, *Groundwater budget, *Edwards Aquifer, *Geohydrology, *Barton Springs, *Texas, Austin, Aquifers, Groundwater recharge, Bacteria, Fluorides, Water quality, Urbanization.

Urban development over the Edwards aquifer in the Austin, Texas, area has caused concerns about the availability and quality of water in the aquifer. The study area, the Edwards aquifer that discharges to Barton Springs, includes parts of Travis and Hays Counties and extends from the city of Kyle to the Colorado River. The aquifer is a karst system composed of limestone and dolomite of Cretaceous age. The water occurs in solution channels in the Edwards and Georgetown Limestones. Yields of adjacent wells often differ by as much as four orders of magnitude. Storage within the aquifer is about 306,000 acre-ft, of which about 31,000 acre-ft is within the 'transient' part of storage--the change in volume occurring between high flow and the lowest known flow of Barton Springs. The average specific yield of the aquifer is 0.017. Three geologic sections are presented in the report, as well as maps showing the altitudes of the base and the top of the Edwards aquifer. Recharge occurs predominantly along faults and fractures crossing six creeks in the recharge area, which covers the western-most 90 sq mi of the aquifer. Leakage probably occurs into the Edwards aquifer from the underlying upper Trinity aquifer. Water budget analyses show that surface recharge and groundwater discharge (springflow and pumpage) are reasonably balanced, suggesting that the groundwater system is in dynamic equilibrium. Based on 65 yr of measurements, Barton Springs has a long-term mean discharge of 50 cu ft/sec and a minimum and maximum discharge of 10 and 166 cu ft/sec. As of 1982, the estimated total groundwater pumpage of about 3,800 acre-ft/yr represented just over 10% of the average annual discharge of 36,000 acre-ft to Barton Springs. Increased pumpage associated with future groundwater development could reduce the discharge at Barton Springs and reduce groundwater availability. Water quality from Barton Springs and the wells is better than the creeks providing surface recharge, which have fecal bacteria values as high as 100,000 colonies/100 ml. Significant densities of fecal bacterial have been found in water from Barton Springs. (Author's abstract)
W89-08786

GROUND-WATER AVAILABILITY IN THE BLACK RIVER BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08790

SURFICIAL GEOLOGY AND GROUND-WATER AVAILABILITY IN THE ALLEGHENY RIVER BASIN AND PART OF THE LAKE ERIE BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08791

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1984,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08792

DETECTION OF CONTAMINANT PLUMES IN GROUND WATER OF LONG ISLAND, NEW YORK, BY ELECTROMAGNETIC TERRAIN-CONDUCTIVITY SURVEYS,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08794

GROUND-WATER LEVELS IN THREE BASALT HYDROLOGIC UNITS UNDERLYING THE COLUMBIA PLATEAU IN WASHINGTON AND OREGON, SPRING 1984,
For primary bibliographic entry see Field 7C.
W89-08795

GROUND-WATER AVAILABILITY IN THE GENESEE RIVER BASIN IN NEW YORK AND PENNSYLVANIA,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08797

DETERMINATION OF GEOHYDROLOGIC FRAMEWORK AND EXTENT OF GROUND-WATER CONTAMINATION USING SURFACE GEOPHYSICAL TECHNIQUES AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08799

GEOPHYSICAL WELL-LOG ANALYSIS OF FRACTURED CRYSTALLINE ROCKS AT EAST BULL LAKE, ONTARIO, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
F. L. Paillet, and A. E. Hess.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4052, 1986. 37p, 23 fig, 1 tab, 22 ref.

Descriptors: *Boreholes, *Geophysics, *Well logs, *Geohydrology, *Subsurface mapping, *Borehole geophysics, *Canada, *Crystalline rocks, *Ontario, Groundwater movement, Geologic fractures, Acoustics, Flow meters.

Various conventional geophysical borehole measurements were made in conjunction with measurements using a recently designed, low-frequency, acoustic-waveform probe and slow velocity flowmeter for characterization of a fractured mafic intrusion in southern Ontario, Canada. Conventional geophysical measurements included temperature, caliper, gamma, acoustic, single-point resistance, and acoustic televiewer logs. Hole stability problems prevented the use of neutron and gamma-gamma logs, because these logs require that a radioactive source be lowered into the borehole. Measurements were made in three boreholes as much as 850 m deep and penetrating a few tens of meters into granitic basement. All rocks within the mafic intrusion were characterized by minimal gamma radiation and acoustic velocities of about 6.9 km/sec. The uniformity of the acoustic velocities and the character of acoustic-waveform logs made with a conventional high-frequency logging source correlated with the density of fractures evident on televiewer logs. Sample intervals of high-frequency waveform logs were transformed into interpretations of effective fracture opening using a recent model for acoustic attenuation in fractured rocks. The new low-frequency sparker source did not perform as expected at depths below 250 m because of previously unsuspected problems with source firing under large hydrostatic heads. A new heat-pulse, slow velocity flowmeter was used to delineate in detail the flow regime indicated in a general way by temperature logs. The flowmeter measurements indicated that water was entering 2 of the boreholes at numerous fractures above a depth of 200 m, with flow in at least 2 of the boreholes exiting through large isolated fractures below a depth of 400 m. (Author's abstract)
W89-08800

ALTITUDE OF THE FRESHWATER-SALTWATER INTERFACE IN A REGIONALLY EXTENSIVE COASTAL PLAIN AQUIFER OF MISSISSIPPI, ALABAMA, AND GEORGIA,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08803

GENERALIZED POTENTIOMETRIC SURFACE OF THE CATAHOULA AQUIFER IN CENTRAL LOUISIANA, 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08804

GROUND WATER IN THE LONG MEADOW AREA AND ITS RELATION WITH THAT IN THE GENERAL SHERMAN TREE AREA, SEQUOIA NATIONAL PARK, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
J. P. Akers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4178, March 1986. 15p, 3 fig, 2 tab, 1 plate, 4 ref.

Descriptors: *Sequoia National Park, *Groundwater movement, *National parks, *California, Hydraulic gradient, Permeability, Geohydrology, Groundwater recharge, Groundwater depletion, Fracture permeability, Groundwater potential.

Westward movement of groundwater from the Long Meadow area of Sequoia National Park, California, to the General Sherman Tree area is prevented by an eastward hydraulic gradient and low fracture permeability of a granodiorite ridge separating the two areas. Clay beds present in the alluvium in the Long Meadow area would hinder, but not preclude, recharge to the groundwater system beneath Long Meadow form streams. A dependable groundwater supply of about 50 gal/min (72,000 gal/day) can be developed from the Long Meadow area. The withdrawal of this quantity of groundwater from the Long Meadow area should not affect ground or surface water in the General Sherman Tree area. (Author's abstract)
W89-08805

SIMULATED EFFECTS OF PROJECTED PUMPING ON THE AVAILABILITY OF FRESHWATER IN THE EVANGELINE AQUIFER IN AN AREA SOUTHWEST OF CORPUS CHRISTI, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08807

HYDROLOGIC AND GEOCHEMICAL MONITORING IN LONG VALLEY CALDERA, MONO COUNTY, CALIFORNIA, 1982-1984,
Geological Survey, Sacramento, CA. Water Resources Div.
C. D. Farrar, M. L. Sorey, S. A. Rojstaczer, C. J. Janik, and R. H. Mariner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4183, 1985. 137p, 39 fig, 6 tab, 2 plates, 60 ref.

Descriptors: *California, *Geophysics, *Geothermal studies, *Monitoring, *Geohydrology, *Geochemistry, *Volcanic springs, *Earthquakes, *Hot springs, Springs, Groundwater level, Helium, Carbon, Thermal springs, Water table, Mapping, Water temperature, Groundwater movement.

The Long Valley caldera is a potentially active volcanic area on the eastern side of the Sierra Nevada in east-central California. Hydrologic and geochemical monitoring of surface and subsurface features began in July 1982 to determine if changes were occurring in response to processes causing earthquakes and crustal deformation. Differences since 1982 in fluid chemistry of springs has been minor except at Casa Diablo, where rapid fluctuations in chemistry result from near surface boiling and mixing. Ratios of 3-He/4-He and 13-C/12-C in hot springs and fumaroles are consistent with a magnetic source for some of the carbon and helium discharged in thermal areas, and observed changes in 3-He/4-He between 1978 and 1984 suggest changes in the magmatic component. Significant fluctuations in hot spring discharge recorded at several sites since 1982 closely followed earthquake activity. Water levels in wells have been used as strain meters to detect rock deformation associated with magmatic and tectonic activity and to construct a water table contour map. Coseismic water level fluctuations of as much as 0.6 ft have been observed but no clear evidence of deformation caused by magmatic intrusions can be seen in the well records through 1984. Temperature profiles in wells, which can be used to delineate regionally continuous zones of lateral flow of hot water across parts of the caldera, have remained constant at all but two sites. (Author's abstract)
W89-08808

MAPS SHOWING GROUND-WATER CONDITIONS IN THE COTTONWOOD CREEK AREA, SHASTA AND TEHAMA COUNTIES, CALIFORNIA, 1983-84,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08809

DIRECTION OF GROUND-WATER FLOW AND GROUND-WATER QUALITY NEAR A LANDFILL IN FALMOUTH, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08810

HYDROGEOLOGY, WATER QUALITY, AND GROUND-WATER DEVELOPMENT ALTERNATIVES IN THE BEAVER-PASQUISET GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
D. D. Dickerman, and M. M. Ozbilgin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4190, 1985. 104p, 50 fig, 14 tab, 46 ref.

Descriptors: *Rhode Island, *Groundwater potential, *Alternative planning, *Groundwater reservoirs, *Geohydrology, *Groundwater quality, *Water resources development, Groundwater management, Hydrologic models, Transmissivity, Groundwater recharge, Groundwater depletion, Pumping.

In a 23 sq mi study area, the Beaver-Pasquiset groundwater reservoir within the Pawcatuck River basin in southern Rhode Island, stratified drift is the only principal geologic unit capable of producing yields > 350 gal/min. Transmissivity of the aquifer ranges from 7,200 to 24,300 sq ft/day. Water table conditions prevail in the aquifer, which is in good hydraulic connection with perennial streams and ponds. A digital model of two-dimensional groundwater flow was used to simulate the interaction between surface water and groundwater, and to evaluate the impact of alternative schemes of groundwater development on groundwater levels, pond levels, and streamflow in the Beaver-Pasquiset groundwater reservoir. Transient simulations of theoretical pumpage were made for a drought period (1963-66) and a wet period (1976-78). The areas most favorable for development of high-capacity wells (350 gal/min or more) are along the Beaver River and near Pasquiset Pond. The water is soft and generally contains < 100 mg/L dissolved solids. Locally, groundwater contains elevated concentrations of iron and manganese (7.5 and 3.7 mg/L, respectively), southeast of Pasquiset Pond, and will require treatment if used for public supply. The groundwater reservoir was simulated with a two-dimensional finite-difference model using a block-centered grid consisting of 33 rows and 75 columns. Differences between measured and simulated water table altitudes for the final steady state run for 21 selected observation wells averaged +0.07 ft. Combined pumping rates for simulation of groundwater development alternatives at eight sites ranged from 3.25 to 7.00 Mgal/d. Pumping rates for individual wells ranged from 0.25 to 1.50 Mgal/d. Transient simulations suggest that the Beaver-Pasquiset groundwater reservoir is capable of sustaining a pumping rate of 4.25 Mgal/d during years of average groundwater recharge with minimal impact on groundwater levels, pond levels, and streamflow. During extreme drought periods (1965 and 1966) it would be necessary to reduce pumpage below 3.25 Mgal/d to maintain flow in both the Beaver River and Pasquiset Brook. (Author's abstract)
W89-08812

GROUND-WATER LEVELS IN THE LOWER PALEOZOIC CARBONATE ROCKS OF WESTERN CHESTER VALLEY, CHESTER COUNTY, PENNSYLVANIA, NOVEMBER 1984,
For primary bibliographic entry see Field 7C.
W89-08816

WATER-QUALITY MAPS FOR SELECTED UPPER CRETACEOUS WATER-BEARING ZONES IN THE SOUTHEASTERN COASTAL PLAIN,
For primary bibliographic entry see Field 7C.
W89-08817

EVALUATION OF SURFACE GEOPHYSICAL METHODS FOR COLLECTION OF HYDROGEOLOGIC DATA IN THE NEBRASKA SAND HILLS REGION,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08818

LAND SUBSIDENCE IN THE SAN JOAQUIN VALLEY, CALIFORNIA, AS OF 1983,
For primary bibliographic entry see Field 6G.
W89-08819

GEOHYDROLOGY OF THE HIGH PLAINS AQUIFER, WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Stullken, K. R. Watts, and R. J. Lindgren.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4198, 1985. 86p, 13 fig, 9 tab, 1 plate, 120 ref.

Descriptors: *Aquifer characteristics, *Geohydrology, *High Plains Aquifer, *Kansas, *Groundwater movement, *Hydrologic maps, *Aquifer systems, Hydraulic conductivity, Groundwater recharge, Hydrologic models, Groundwater quality, Groundwater budget, Groundwater drainage, Irrigation, Dissolved solids.

The High Plains aquifer underlies 174,050 sq mi of eight states (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) and contains approximately 3.3 billion acre-ft of water in storage. Saturated thicknesses within the aquifer are as great as 600 ft near the southern border of southwest Kansas. The aquifer is replenished primarily by infiltration from precipitation. Average precipitation at the Garden City Experiment Station is 18.93 in/yr. Groundwater flow is generally from west to east under unconfined conditions. Hydraulic connection with subcropping consolidated aquifers allows ground water to flow vertically in minor quantities. The aquifer is depleted primarily by irrigation. Hydraulic conductivity estimates from 1,612 lithologic logs had an average value of 75 ft/day, with a standard deviation of 35 ft/day. Specific yields estimated from the same lithologic logs had a mean of 0.17 and a standard deviation of 0.047. Water from the High Plains aquifer in Kansas generally is suitable for human and animal consumption and irrigation of crops. Typically, it is a calcium bicarbonate type water, with concentrations of total dissolved solids ranging from 250 to 500 mg/L. The quality of water in the aquifer deteriorates toward the east due to mixing with recharge water containing dissolved minerals leached from the overlying soil and unsaturated zones and mineralized water from adjacent bedrock units. The simulated water budget for the steady state model of predevelopment (pre-1950) conditions in the High Plains aquifer in northwest Kansas showed that annual recharge to the aquifer from infiltration of precipitation was 87,000 acre-ft/yr and from boundary inflow, 21,000 acre-ft/yr. Annual discharge from the aquifer was 108,000 acre-ft/yr, including 81,000 acre-ft/yr from leakage to streams, 23,000 acre-ft from outflow at the boundaries of the aquifer, and 4,000 acre-ft from municipal and industrial pumpage. (Lantz-PTT)
W89-08821

EVALUATION OF THE BEDROCK AQUIFER SYSTEM IN NORTHEASTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
P. J. Emmons.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4199, 1987. 48p, 28 fig, 4 tab, 30 ref.

Descriptors: *Aquifer systems, *Aquifer characteristics, *Bedrock, *Wisconsin, *Geohydrology, Groundwater movement, Transmissivity, Hydraulic conductivity, Hydrologic models, Model studies.

Groundwater is a major source of water in northeastern Wisconsin. This report evaluates the bedrock aquifer system in northeastern Wisconsin and describes how the flow regimes in the system have been altered due to groundwater withdrawals. A three-dimensional finite-difference groundwater flow model was used to aid in evaluation of the regional flow system. In order to simplify the study of the aquifer system, the geologic units were grouped into eight geohydrologic units consisting of fur aquifers and four confining beds. The aquifers are the more permeable sand and gravel layers in the surficial deposits (aquifer 4), Devonian dolomite-Silurian dolomite (aquifer 3), St. Peter Sandstone-Prairie du Chien Group-Jordan Sandstone Member of the Trempealeau Formation (aquifer 2), and the Galesville Sandstone-Eau Claire Sandstone-Mount Simon Sandstone (aquifer 1). The confining beds are the less permeable silts and clays in the surficial deposits (confining bed 4), Maquoketa Shale-Galena Dolomite-Decorah Shale-Platteville Formation (confining bed 3), St. Lawrence Member of the Trempealeau Formation-Franconia Sandstone (confining bed 1). The following aquifer and confining-bed characteristics were determined to represent the aquifer system of northeastern Wisconsin and were used in the development of the model. Aquifer 4 acts as an upper boundary of the bedrock aquifer system. The hydraulic conductivity of aquifer 3 was 7.9 ft/day and the storage coefficient was estimated to be 0.01. Transmissivity input values to the model for aquifer 2 are based on hydraulic conductivities ranging from 3 to 8 ft/day. The storage coefficient for aquifer 2 was 0.0002. The transmissivity input values to the model for aquifer 1 are based on hydraulic conductivities ranging from 2.5 to 8 ft/day and the storage coefficient was 0.0002. A vertical hydraulic conductivity of 0.007 ft/day was assigned to represent confining bed 4. The vertical hydraulic conductivity of confining bed 3 was assigned values of 0.0001 to 0.000004 ft/day. A value of 0.0001 ft/day was used as the vertical hydraulic conductivity for confining bed 2. Confining bed 1 is a lower boundary of the system and was not modeled. Model simulations indicate that, by 1914, groundwater withdrawals from the aquifer system had already impacted the study area. (Author's abstract)
W89-08822

SIMULATION OF THE EFFECTS OF MANAGEMENT ALTERNATIVES ON THE STREAM-AQUIFER SYSTEM, SOUTH FORK SOLOMON RIVER VALLEY BETWEEN WEBSTER RESERVOIR AND WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08823

SIMULATION ANALYSIS OF WATER-LEVEL CHANGES IN THE NAVAJO SANDSTONE DUE TO CHANGES IN THE ALTITUDE OF LAKE POWELL NEAR WAHWEAP BAY, UTAH AND ARIZONA,
Geological Survey, Salt Lake City, UT. Water Resources Div.
B. E. Thomas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4207, 1986. 45p, 15 fig, 5 tab, 20 ref.

Descriptors: *Surface-groundwater relations, *Model studies, *Simulation analysis, *Groundwater level, *Environmental effects, *Water resources development, *Lake Powell, *Utah, *Arizona, Wahweap Bay, Groundwater recharge, Hydraulic conductivity, Water level, Flow profiles, Groundwater movement, Groundwater storage, Equilibrium, Reservoirs.

A two-dimensional, finite difference, digital computer model was used to simulate various concepts of groundwater flow near Wahweap Bay, Lake Powell. The filling of Lake Powell started in March 1963; and by 1983 the lake had risen almost 550 ft. This resulted in a maximum observed water level rise of 395 ft in a well in the Navajo Sandstone 1 mi from the lake. A steady-state model was prepared with subsurface recharge rates of 5,720 acre-ft/yr, 10,440 acre-ft/yr, and 14,820 acre-ft/yr, resulting in a range of hydraulic conductivity of 0.25 to 3.38 ft/da. Comparing measured and simulated water level changes resulted in a range of specific yield of 0.02 to 0.15. Using larger values for hydraulic conductivity in the model area corresponding to the axis of the Wahweap syncline and the Echo monocline was instrumental in attaining a reasonable match for the water level distribution. This supports previous concepts that areas where rocks are structurally deformed more readily transmit groundwater because of the higher degree of fracturing. Using the most likely simulation of the flow system, groundwater storage in the Navajo increased by about 25,000 acre ft/mi of shoreline form 1963-83, but the flow system will require about 400 yr to reach a state of equilibrium. (Author's abstract)
W89-08826

ESTIMATION OF NATURAL GROUNDWATER RECHARGE.
D. Reidel Publishing Company, Boston. NATO ASI Series. Series C: Mathematical and Physical Sciences Vol. 222. 1988. 510p. Edited by I. Simmers.

Descriptors: *Groundwater recharge, *Aquifers, *Groundwater movement, *Recharge, *Model studies, Remote sensing, Groundwater management, Sand aquifers, Karst, Case studies.

This book contains the proceedings of a NATO Advanced Research Workshop held within the program of activities of the NATO Special Program on Global Transport Mechanisms in the Geo-Sciences running from 1983 to 1988 as part of the activities of the NATO Science Committee. The workshop was held to critically address such specific topics as recharge determination methodology, estimation with inadequate data and regionalization of point observations. The scientific programs of the workshop were divided into sessions on recharge concepts, physical/chemical recharge estimation techniques, numerical modelling recharge estimation techniques, applications and case studies, and a comparative analysis with humid zone recharge. In the opening session, answers were sought to questions relating to the mechanisms of groundwater recharge, the limiting conditions (climatic, physiographic, data availability) of basic recharge estimation, remote sensing of groundwater recharge, and deficiencies in information between recharge theory and application. (See W89-08831 thru W89-08862) (Geiger-PTT)
W89-08830

GROUNDWATER RECHARGE CONCEPTS,
Stavebni geologie n.p., Gorkeho nam. 7, 113 09 Prague 1, Czechoslovakia.
J. Balek.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 3-9, 16 ref.

Descriptors: *Recharge, *Groundwater recharge, *Groundwater movement, *Infiltration, Saturated zone, Unsaturated zone, Permeability coefficient, Arid-zone hydrology, Groundwater management, Spatial distribution, Seasonal variation.

Groundwater recharge is usually considered a process of water movement downward through the saturated zone under the forces of gravity or in a direction determined by the hydraulic conditions. Natural recharge of groundwater may occur by precipitation, by rivers and canals and by lakes. Four types of groundwater recharge (short-term recharge, seasonal recharge, perennial recharge and historical recharge) are discussed. Short-term recharge occurs occasionally after a heavy rainfall, mainly in regions without marked wet and dry seasons. Seasonal recharge occurs regularly, e.g. at the beginning or the snowmelt period in temperate regions or during the wet period in wet and dry regions. A continuous perennial recharge may occur in parts of the humid tropics where there exists nearly permanent downward flow of water.

Historical recharge occurred a long time ago and contributed to the formation of the present groundwater resources. Soil and aquifer properties including recharge processes vary from place to place both laterally and vertically. Factors affecting recharge include slope of the surface and slope of the boundary between soil layers, vertical spatial variability of the profile, permeability coefficient, capillarity, and soil and rock characteristics. In arid and semi-arid regions, recharge through streams is more frequent. More experiments should be performed under ecological conditions of aridity to replace theories developed under temperate climate conditions. (See also W89-08830) (Geiger-PTT)
W89-08831

UNEXPECTED FACTOR AFFECTING RECHARGE FROM EPHEMERAL RIVER FLOWS IN SWA/NAMBIA,
Department of Water Affairs, Windhoek (Namibia).
S. Crerar, R. G. Fry, P. M. Slater, G. van Langenhove, and D. Wheeler.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 11-28, 12 fig, 4 tab, 2 ref.

Descriptors: *Recharge, *Groundwater recharge, *Ephemeral streams, *Groundwater movement, *Mathematical models, Flood flow, Alluvium, Semiarid lands, Silt, Flow velocity, Unsaturated zone.

The processes controlling recharge to alluvial groundwater have presented complex and even intractable hurdles to accurate estimates of this parameter. Casual observations in ephemeral rivers in SWA/Nambia have indicated that variable recharge quantities result from similar flood events. For this reason the Department of Water Affairs initiated a research project to identify and investigate relevant parameters. Three natural channel sections were identified for instrumentation, a simulated channel was constructed under laboratory conditions, and the basis of a mathematical model laid down. Preliminary results are reported for the first fully instrumented natural river channel for which two seasons of flood flow and resultant recharge data are available. These results are compared with laboratory trials for a range of flow regimes. While this work is at an early stage it has already become clear that silt carried by flood waters can effectively seal the alluvial surface even during the flood event at unexpectedly high flow velocities. Thus the other processes controlling recharge in the unsaturated zone may become relatively unimportant for much of the duration of any given flood event. (See also W89-08830) (Author's abstract)
W89-08832

CONTINUITY OF AQUIFER SYSTEMS ON THE CRYSTALLINE BASEMENT OF BURKINA FASO,
Iwaco B.V., Rotterdam (Netherlands).
J. J. van der Sommen, and W. Geirnaert.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 29-45, 10 fig, 2 tab, 14 ref.

Descriptors: *Geohydrology, *Aquifer systems, *Africa, *Geologic fissures, *Groundwater recharge, Groundwater movement, Regional analysis, Niger, Ghana, Groundwater level, Geologic fractures, Water supply development, Bedrock.

Two types of aquifer are present on the West African Shield: those in the hardrock, connected with fault and fissure systems, and the weathered mantle aquifer. This hydraulically connected aquifer system is generally regarded as highly discontinuous with individual compartments in which isolated groundwater circulation occurs. Extensive drilling for rural and urban water supply in Burkina Faso, Niger and Ghana has, however, brought evidence for the presence of a continuous piezometric surface over large areas. Hydrochemical and isotope data and the cyclic fluctuation of groundwater levels provide evidence for a regional recharge-discharge system. The importance of this regional system increases from north to south in tandem with higher precipitation. The hypothesis of a substantial lateral flow in the fault and fissure system was applied in the study for the location of new well fields for the capital of Burkina Faso, Ouagadougou. The study for the future water supply of Ouagadougou suggests that for high yield urban water supply wells, both components of the aquifer system should be well developed, i.e., a thick saturated weathered mantle and fractured bedrock with good lateral continuity. (See also W89-08830) (Author's abstract)
W89-08833

REVIEW OF SOME OF THE PHYSICAL, CHEMICAL AND ISOTOPIC TECHNIQUES AVAILABLE FOR ESTIMATING GROUNDWATER RECHARGE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 49-72, 5 fig, 76 ref.

Descriptors: *Recharge, *Groundwater recharge, *Isotopic tracers, *Percolation, *Chlorides, Groundwater movement, Infiltration, Tritium, Radioactive tracers.

Some physical, chemical, and isotopic techniques available for estimating groundwater recharge to unconfined aquifers in areas of relatively low rainfall (<700 mm/a) are reviewed. It is likely that, the greater the aridity, the smaller and more variable the recharge flux will become. Chemical and isotopic methods are likely to be more successful than the physical methods which rely on a direct measurement of a water flux. The diffusivity of tracers is much less variable with change in water content or soil type than the diffusivity of soil water. Tracer behavior represents a much more robust indicator of water movement in a porous medium than does the solution of the equations of water flow, especially in the unsaturated zone. In estimating recharge, tritium relies on estimation of the amount of the tracer beneath the soil surface, thus the precision of the estimate of recharge will increase with recharge rate. For chloride tracers, the concentration of which is inversely proportional to recharge rate, the precision of the estimate will increase with decrease in recharge rate. Lack of chloride data in precipitation can be a severe limitation to its usefulness as a tracer in recharge estimations. New low-background counters for tritium have ensured the usefulness of this radioisotope for recharge studies. The estimation of recharge rate from investigation of profiles of tracer concentration (e.g. chloride) under some conditions, relies critically on a knowledge of the tracer diffusivity and hence on tortuosity. Estimation of tortuosity remains a critical problem as does the prediction of recharge variability. Over some large areas groundwater recharge appears to show little lateral variability, while in other, apparently similar areas it can range over at least an order of magnitude. Rapid and non-destructive techniques such as electromagnetic methods may offer some help in overcoming these problems in recharge estimation. (See also W89-08830) (Geiger-PTT)
W89-08834

SATELLITE REMOTE SENSING AND ENERGY BALANCE MODELLING FOR WATER BALANCE ASSESSMENT IN SEMI-ARID REGIONS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
A. A. van de Griend, and R. J. Gurney.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 89-116, 10 fig, 1 tab, 46 ref.

Descriptors: *Recharge, *Hydrologic budget, *Heat budget, *Semiarid lands, *Satellite technology, *Soil water, *Groundwater recharge, *Remote sensing, Infrared imagery, Biomass, Evapotranspiration, Models, Energy.

Water balance in semi-arid regions may be monitored using different types of remotely sensed information from satellites. Such an approach focusses on monitoring the soil moisture status and evapotranspiration over time from the combination of thermal infrared, visible and near infrared and passive microwave remote sensing. Application of such an approach may give a better insight into the spatial and temporal variability of soil moisture content and evapotranspiration, and may contribute to a better understanding of large scale recharge phenomena in semi-arid regions. Actual recharge depends on subsurface hydrogeological conditions for percolation to underlying aquifers, and may vary between localized concentrated percolation on the one hand and more regional diffuse percolation on the other. Thus a subsurface scaling problem comes to the foreground which is beyond the remote sensing approach described which focusses on the average surface conditions at pixel scale, as a possible boundary condition for recharge. The surface energy balance may be modelled using thermal infrared surface temperature observations and large scale near surface meteorological information, which allows the evapotranspiration rate to be estimated and the soil moisture status to be inferred together with stress conditions of the vegetation. This requires a remotely sensed estimate of the vegetation cover and biomass which may be derived from visible and NIR signatures. Separately, the soil moisture status of the top soil may be derived from passive microwave signatures. The aspects of an energy and mass balance model to be used in the data analysis for scarcely vegetated areas such as in semi-arid regions are described. (See also W89-08830) (Author's abstract)
W89-08836

PROPOSED STUDY OF RECHARGE PROCESSES IN FRACTURE AQUIFERS OF SEMI-ARID BOTSWANA,
Botswana Univ., Gaborone. Faculty of Science.
A. Gieske, and E. Selaolo.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 117-124, 2 fig, 18 ref.

Descriptors: *Groundwater recharge, *Botswana, *Aquifer systems, *Recharge, *Groundwater movement, Project planning, Monitoring, Soil water, Vegetation, Evapotranspiration, Unsaturated zone, Soil moisture retention, Rainfall, Semiarid lands.

Determination of groundwater recharge in semi-arid regions by the classical water balance approach is of limited practical value, because in general the evapotranspiration and the groundwater discharge component are not directly measurable. Moreover, the storage of moisture in the unsaturated zone and the rates of infiltration along the various possible routes to the aquifer form important and uncertain factors. A thorough and long term study linked with plans to extend and upgrade the existing groundwater monitoring network of important aquifers in eastern Botswana is proposed. The study will encompass not only moisture transport, but also dynamic aspects of groundwater replenishment. Classification of rainfall events will be combined with soil physical measurements, isotope analyses of chloride concentrations to determine recharge, and studies of solute transport in the unsaturated zone. (See also W89-08830) (Author's abstract)
W89-08837

ESTIMATION OF NATURAL GROUNDWATER RECHARGE UNDER SAUDI ARABIAN ARID CLIMATIC CONDITIONS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrology.
M. J. Abdulrazzak, A. U. Sorman, and O. A. Rizaiza.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 125-138, 7 fig, 3 tab, 3 ref.

Descriptors: *Groundwater recharge, *Infiltration, *Wadi, *Mathematical models, *Recharge, *Arid lands, *Saudi Arabia, Alluvial deposits, Regression analysis, Evapotranspiration, Monitoring, Rainfall,

Runoff, Soil temperature, Soil water, Flood hydrographs, Water table.

The infiltration-recharge phenomena was investigated in a representative alluvial wadi system to determine the factors influencing it and to formulate a groundwater recharge model. A three kilometer experimental reach in one of the representative basins of the southwestern part of Saudi Arabia was instrumented with a data acquisition system to continuously monitor hydrological variables on rainfall, runoff, groundwater fluctuations, evapotranspiration, and soil temperature and moisture variation. Analysis of data revealed different recharge responses at each well due to soil heterogeneity and moisture variation. The developed regression models show that the maximum flood hydrograph depth is the most important factor affecting recharge. Also, factors such as rainfall depth and depth to water table affected the recharge rate. (See also W89-08830) (Author's abstract)
W89-08838

SOLUTE PROFILE TECHNIQUES FOR RECHARGE ESTIMATION IN SEMI-ARID AND ARID TERRAIN,
British Geological Survey, Edinburgh (Scotland). Hydrogeology Research Group.
W. M. Edmunds, W. G. Darling, and D. G. Kinniburgh.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 139-157, 6 fig, 4 tab, 14 ref.

Descriptors: *Recharge, *Tracers, *Groundwater recharge, *Solute transport, *Semiarid lands, *Arid lands, Chlorides, Isotopic tracers, Sudan, Groundwater movement, Cyprus, Unsaturated zone.

Conventional methods for recharge estimation have limitations when applied to arid and semi-arid regions; the use of tritium profiles is also not always applicable. Unsaturated zone solute profiles, using a reference solute such as chloride, offer an alternative technique. Sampling may be undertaken by percussion drilling, augering or from dug wells; the methods developed are described and examples discussed. Recharge estimates using chloride profiles from Cyprus (420 mm mean annual rainfall) are in good agreement with results estimated from tritium profiles and indicate a mean annual recharge of around 50 mm/year. In Central Sudan (180 mm mean annual rainfall), good agreement was found between adjacent unsaturated zone chloride profiles and these indicated a net annual direct recharge via interfluve areas of around 1 mm/year. It is concluded that solute profiles offer a cheap and effective tool for estimating direct recharge in porous lithologies of semi-arid regions and also for investigating recharge history, providing input data for chloride are available. In more arid regions, however, a component of discharge may occur during hyperarid episodes. Further validation of moisture composition using stable isotope techniques is required under such conditions. (See also W89-08830) (Author's abstract)
W89-08839

RECHARGE ESTIMATION FROM THE DEPTH-DISTRIBUTION OF ENVIRONMENTAL CHLORIDE IN THE UNSATURATED ZONE-WESTERN AUSTRALIAN EXAMPLES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 159-173, 5 fig, 26 ref.

Descriptors: *Recharge, *Tracers, *Arid lands, *Groundwater recharge, *Chlorides, *Aeration zone, *Australia, Mathematical models, Solute transport, Groundwater movement, Infiltration, Soil profiles.

Methods for computing long-term average recharge rates to groundwater from the analyses of the depth-distribution of environmental chloride in the unsaturated zone are presented. A one-dimensional equation, incorporating convective and diffusion terms, describing steady-state transport of non-reactive solutes, is solved in an inverse fashion, enabling computation of the depth-distribution of vertical water flux density. This and other simplified models were applied to interpret the observed chloride profiles beneath native vegetation in two coastal regions of Western Australia. The presence of preferred pathways for water movement has been suggested for both regions. In the sandy coastal region, the overall recharge was some 15% of the annual precipitation (775 mm/yr). Over 50% of this recharge occurs through preferred pathways. In the profiles of the southwestern region, the majority of recharge occurs through preferred pathways since the estimated recharge through the soil matrix is negligible (<0.5% annual rainfall). The limitations of using a simple one-dimensional model for such complex lateritic profiles are discussed. One of the major limitations is that in the one-dimensional analysis, the lateral flow of water and Cl(-) above the clayey subsoil layer is ignored, while other evidence suggests that this component may induce a substantial loss of Cl(-). (See also W89-08830) (Author's abstract)
W89-08840

NATURAL RECHARGE MEASUREMENTS IN THE HARD ROCK REGIONS OF SEMI-ARID INDIA USING TRITIUM INJECTION-A REVIEW,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
R. N. Athavale, and R. Rangarajan.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 175-194, 6 fig, 2 tab, 14 ref.

Descriptors: *Tracers, *Recharge, *Groundwater recharge, *India, *Semiarid lands, *Tritium, *Isotopic tracers, Aquifers, Monsoons, Soil profiles, Soil water, Rainfall, Artificial recharge.

Natural recharge to phreatic aquifers of the semi-arid rocky region of India has been estimated for several large basins (area 500 sq km and more) and two watersheds (area around 50 sq km) using the tritium injection technique. Tritium was injected at representative sites before onset of monsoons and the displacement of tritium peak and variation of moisture content in vertical soil profiles collected in the post-monsoon period were used for determining spot values of recharge due to precipitation. The average recharge values showed a range from almost nil to about 100 mm depending upon the soil type, temperature, rainfall amount and pattern, and hydrogeological conditions. Data for various basins is presented and evaluated. Some general features emerging from these measurements, conducted during the last ten years are discussed. Infiltration and runoff due to a precipitation event depend upon the amount and intensity of rainfall as well as the antecedent moisture condition of the soil profile. The cumulative recharge due to a monsoon season, made of several precipitation events, is also considerably dependent on the characteristics of the events as well as their spacing. The effect of grain size on recharge values and the diffusion of injected tritium activity in soil was examined. The average recharge values for Vertic and Alfic soils, receiving approximately same quantity of rainfall, are comparable. Results from the tritium injection recharge measurement method showed a broad agreement between the results from different recharge measurement methods using water level fluctuation, hydrometeorological data, regional groundwater models, and hydrogeological estimates. (See also W89-08830) (Geiger-PTT)
W89-08841

COMPARISON OF RECHARGE ESTIMATES FROM INJECTED TRITIUM TECHNIQUE AND REGIONAL HYDROLOGICAL MODELLING IN THE CASE OF A GRANITIC BASIN IN SEMI-ARID INDIA,
National Geophysical Research Inst., Hyderabad (India).
D. Muralidharan, C. S. Murti, and R. N. Athavale.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 195-204, 3 fig, 1 tab, 4 ref.

Descriptors: *Recharge, *Tracers, *Model studies, *Groundwater recharge, *Isotopic tracers, *Tritium, *India, Hydrologic models, Geohydrology, River basins, Model testing, Monsoons, Regional analysis, Aquifers.

The injected tritium technique was used for estimation of recharge from 1978 monsoon precipitation to the phreatic aquifers of the West Survarnamukhi sub-basin, forming a part of the Vedavati basin and having an area of 958 sq km., covered with granite, gneisses, and schists. Recharge was measured at 20 sites, of which 6 were in schists and the rest in gneisses. Displacement of tritium tracer peak in the unsaturated Alfisol zone was used for measuring the spot values of recharge which varied from 0 mm to 127 mm. The average recharge calculated from spot values was found to be 39.2 mm or 8.5% of the seasonal rainfall. The input to the groundwater regime of the basin, calculated by using the Thiessen polygon method works out to be 43.8 million cu m. A regional groundwater model of the Vedavati basin has recently been prepared. Based on water level fluctuation data for the period November 1977 to November 1978, these authors have estimated the annual recharge for various parts of the Vedavati basin. The annual recharge or safe yield value for West-Survarnamukhi basin, obtainable from the model, is 42.5 mm. Thus, an agreement between recharge values estimated from tritium injection in the unsaturated zone, and from a model calibrated with water level fluctuations in the saturated zone is observed in the case of West Survarnamukhi basin. A similar agreement with an average recharge value of 34.4 mm, estimated from a climatic water balance study, is also noteworthy. (See also W89-08830) (Author's abstract)
W89-08842

STUDIES ON NATURAL RECHARGE TO THE GROUNDWATER BY ISOTOPE TECHNIQUES IN ARID WESTERN RAJASTHAN, INDIA,
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
H. Chandrasekharan, S. V. Navada, S. K. Jain, S. M. Rao, and Y. P. Singh.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 205-220, 8 fig, 5 tab, 20 ref.

Descriptors: *Recharge, *Tracers, *Groundwater recharge, *Arid zone, *India, *Groundwater potential, *Isotopic tracers, Tritium, Cobalt radioisotopes, Infiltration, Aquifer systems.

Environmental (H2, O18, and C14) and artificial (H3 and Co60) isotopes were used to study the nature of recharge and recharge conditions of groundwater in certain parts of arid Western Rajasthan. Investigations carried out for three years since 1982 indicate that the natural recharge to the groundwater in the investigated areas may occur once in several years either by direct infiltration of local intense precipitation or through river channels from episodic flash floods or remotely from distant outcrops. Most of the arid areas have very little contribution towards groundwater from local precipitation with few exceptions. The natural recharge in the Siwana region was about 1% of the rainfall from 1982 to 1985 and at Jodhpur about 13% from 1983 to 1985. The environmental isotope study shows that the artesian flowing well and other deep dug/tube wells have waters which are ancient and recharged during a more moist and cool period than the present. The deep wells were possibly recharged remotely through distant outcrop areas. The shallow and deeper aquifers appear to be interconnected as evidenced by their stable isotopic compositions. (See also W89-08830) (Geiger-PTT)
W89-08843

NUMERICAL AND CONCEPTUAL MODELS FOR RECHARGE ESTIMATION IN ARID AND SEMI-ARID ZONES,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 223-238, 5 fig, 18 ref.

Descriptors: *Model studies, *Recharge, *Groundwater recharge, *Soil water, *Mathematical models, Unsaturated zone, Runoff, Numerical analysis, Arid lands, Semiarid lands, Infiltration, Groundwater movement.

Recharge estimation can be based on a wide variety of models which are designed to represent the actual physical processes. The direct estimation of recharge using soil moisture balance models, recharge due to losses from irrigation schemes, the influence of the unsaturated zone and recharge due to rivers and other sources of runoff such as infiltration due to surface flows are considered. A study of the water table fluctuation method indicates that indirect methods often provide unreliable estimates. Several examples are included to demonstrate that, by identifying and representing the flow mechanisms, realistic estimates of recharge can be made. The long term change in water table elevation can be used as a check on recharge estimates. (See also W89-08830) (Author's abstract)
W89-08844

METHODS FOR ESTIMATION OF NATURAL GROUNDWATER RECHARGE DIRECTLY FROM PRECIPITATION-COMPARATIVE STUDIES IN SANDY TILL,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
P. O. Johansson.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 239-270, 16 fig, 3 tab, 38 ref.

Descriptors: *Recharge, *Groundwater recharge, *Precipitation, *Runoff, Sweden, *Hydrologic models, Soil water, Soil moisture deficiency, Flow discharge, Groundwater movement, Chlorides, Groundwater level.

Six different methods for estimation of natural groundwater recharge directly from precipitation were tested and compared in a sandy till area in southeastern Sweden. A one dimensional soil water flow model was tested against observed groundwater levels. The fit between simulated and observed groundwater levels was shown to be rather insensitive to displacements between evapotranspiration and groundwater recharge. Applying a single soil moisture reservoir method, recharge had to be allowed even when a moisture deficit existed in order to correctly reproduce the dynamics revealed as groundwater level fluctuations. The estimation made from groundwater level fluctuations and a specific yield value was not satisfactory. Comparisons of chloride deposition and concentration in spring discharge gave promising results for studies of relative areal variability of recharge. Spring discharge measurements and a catchment area model, calibrated against them, gave valuable information of total recharge quantities, which could be used for comparisons with the other methods. The study demonstrated the need for comparative studies with several methods, since all estimations suffered from substantial uncertainty. (See also W89-08830) (Author's abstract)
W89-08845

PRINCIPLES OF INVERSE MODELLING FOR ESTIMATION OF RECHARGE FROM HYDRAULIC HEAD,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
H. Allison.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 271-282, 19 ref.

Descriptors: *Groundwater recharge, *Mathematical models, *Groundwater movement, *Recharge, *Model studies, Remote sensing, Finite difference methods, Error analysis, Hydraulic properties.

The Boussinesq equation permits, in principle, estimation of recharge for steady groundwater flow by taking derivatives of hydraulic head and transmissivity functions. However, some obstacles for this procedure are encountered. Taking derivatives of the spatially-distributed data, even when they are known at every point, leads to numerical instability. Hydraulic heads are always measured with inaccuracies. Differentiating this noisy data leads to large errors in recharge estimation. By using a special modification of the Boussinesq equation it is possible to overcome all three difficulties simultaneously. The methods of recharge estimation proposed are suitable for taking spatial derivatives from noisy measurements in other fields of science and might be useful in remote sensing for edge enhancement. (See also W89-08830) (Author's abstract)
W89-08846

ESTIMATING NATURAL RECHARGE OF GROUND WATER BY MOISTURE ACCOUNTING AND CONVOLUTION,
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
J. Willemink.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 283-299, 4 fig, 10 ref.

Descriptors: *Recharge, *Model studies, *Hydrologic budget, *Groundwater recharge, *Mathematical models, *Runoff, Water table fluctuations, Rainfall, Soil water, Evapotranspiration, South Africa, Groundwater movement, Optimization.

A numerical model has been developed for calculating the groundwater recharge at areas without or with a thin soil cover (up to 20 cm) underlain by hard-rock formations. The system is simulated by hyrologic routing through a number of serially arranged linear reservoirs. The point rainfall is being converted, by daily moisture accounting, into effective rainfall. This, in turn, is being converted into the water-table response by the convolution operation. The unknown model parameters are calibrated, using an automatic optimization procedure based on the criterion to minimize the error differences between the recorded water-table recovery and the simulated one. The minimum required input data are daily readings of the water table in an observation well, near the topographic water divide (or just downstream an aquifuge), and daily rainfall figures from a rain gauge close to the well. The proposed model has been applied to a site in the central part of South Africa with promising results. (See also W89-08830) (Author's abstract)
W89-08847

NATURAL GROUND WATER RECHARGE ESTIMATION METHODOLOGIES IN INDIA,
Central Ground Water Board, New Delhi (India).
B. P. C. Sinha, and S. K. Sharma.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 301-311, 3 tab, 6 ref.

Descriptors: *Recharge, *Groundwater recharge, *Mathematical models, *India, *Hydrologic budget, Precipitation, Water table fluctuations, Rainfall, Water resources development, Groundwater level.

Rainfall is the most important source of groundwater recharge in India. Natural recharge to an aquifer in a groundwater basin from precipitation is computed in India by empirical methods, hydrologic budgeting methods, and groundwater level fluctuations methods. Several empirical relationships have been devised for computation of natural recharge to groundwater from rainfall. Among these, the Chaturvedi formula, and the method formulated by the Central Ground Water Board from the studies in the Vedavati River Basin Project, Karnataka are discussed. Hydrologic budgeting methods have been applied using estimation of recharge by analysis of hydrometeorological data from the Ghaggar River Basin, and by soil-moisture balance methods in Sikar Luni and Kikaner Basins of Rajasthan. Groundwater levels are being monitored by different organizations in India from two to four times a year based on the rainfall pattern. Estimation of groundwater recharge and the extent of its utilization in various parts of the country for speedy groundwater development has been based on various empirical methods. These studies yielded valuable data from the varied hydrogeological situations in India and concerted efforts were made to rationalize recharge estimation methodology all over the country. In 1982 the government of India formed a Ground Water Estimation Committee. This committee has recommended norms for estimation of groundwater recharge by the water level fluctuation method as tested by well hydrographs. (See also W89-08830) (Geiger-PTT)
W89-08848

BALSEQ-A MODEL FOR THE ESTIMATION OF WATER BALANCES, INCLUDING AQUIFER RECHARGES, REQUIRING SCARCE HYDROLOGIC DATA,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. P. Lobo Ferreira, and J. Delgado Rodrigues.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 313-319, 1 fig, 3 ref.

Descriptors: *Recharge, *Model studies, *Groundwater recharge, *Mathematical models, *Hydrologic budget, *Computer models, Precipitation, Runoff, Evapotranspiration, Soil water, Vegetation effects, Semiarid lands, Portugal, Overland flow, Model testing.

A mathematical model (BALSEQ) for the estimation of daily sequential water balances updates the following hydrologic variables: precipitation, runoff, evapotranspiration, soil moisture and deep recharge of aquifers. As output the model reports: total values of input parameters (rainfall and potential evapotranspiration), their annual and monthly mean values and standard deviations; estimated results of runoff (overland flow), real evapotranspiration and deep infiltration; soil moisture on the last day of each month included in the balance period; and data related to overland flow (the data of the event, the total rainfall and the computed amount of overland flow). The model was applied to three case studies of recharge estimation on the island of Porto Santo, the semiarid region of Faro, and the Rio Maior area which indicated the importance of top soil conditions and vegetation in the estimation of groundwater recharge. Experience gathered with the use of the BALSEQ model shows that very precise results should not be expected from its use. However, the existence of an acceptable range of values for runoff and aquifer recharge provided by the model may be useful in water resources evaluation, when only scarce hydrologic and hydrogeologic data are available. (See also W89-08830) (Author's abstract)
W89-08849

QUANTIFICATION OF GROUNDWATER RECHARGE IN ARID REGIONS: A PRACTICAL VIEW FOR RESOURCE DEVELOPMENT AND MANAGEMENT,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
S. S. D. Foster.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 323-338, 11 fig, 1 tab.

Descriptors: *Recharge, *Model studies, *Hydrologic budget, *Withdrawal, *Groundwater recharge, *Arid lands, *Mathematical models, Aquifers, Peru, Botswana, Numerical analysis, Developing countries, Groundwater management.

The rate of aquifer replenishment is one of the most difficult of all factors in the revaluation of groundwater resources to measure. Estimates, by whatever method, are normally, and almost inevitably, subject to large error. Through discussion of a logical series of questions, the manner in which this factor affects practical resource development and management are defined and the limitations of

various evaluation methods are discussed, with reference to examples from arid regions, especially the Botswana Kalahari and the Peruvian Atacama. When confronted by such uncertainty technical and economic analyses of sensitivity of development and management decisions to error in recharge estimates is essential. A pragmatic approach involving careful monitoring of aquifer response to heavy medium-term abstraction in a representative area and subsequent data evaluation using a distributed-parameter numerical aquifer model is advocated. This will often be the only realistic way forward given normal project constraints and data limitations under complex hydrogeological conditions and in developing nations, and will also allow time for appropriate field research into groundwater recharge mechanisms and storage controls. (See also W89-08830) (Geiger-PTT)
W89-08850

GROUNDWATER RECHARGE STUDIES IN SEMI-ARID BOTSWANA-A REVIEW,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
J. J. de Vries, and M. von Hoyer.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 339-347, 1 fig, 13 ref.

Descriptors: *Recharge, *Semiarid lands, *Groundwater recharge, *Botswana, *Isotopic tracers, Hydrologic budget, Chlorides, Soil water, Aquifers, Runoff, Infiltration, Percolation, Rainfall.

Some 80% of the surface of Botswana is mantled with thick layers of Late-Cretaceous to recent sandy deposits of the Kalahari semi-desert. Sedimentary and crystalline rocks of pre-Cretaceous age occur at or near the surface in the remaining eastern part of the country. Groundwater basins have been encountered in the bedrock below the Kalahari deposits all over the area, but no unanimity has been reached on the question of the existence of any present-day recharge. Replenishment of the aquifers in the outcrop areas of solid rocks is not disputed, but no reliable figures on the percolation rate could be established as yet. Various investigations and methods were applied to estimate recharge in Botswana. These include: soil moisture retention studies, isotopic tracer studies, a hydraulic gradient approach, water balance studies, and a chloride balance method. From the still incomplete observations in the Lobatse area, it is concluded that recharge varies widely with respect to place and time and that care should be taken in applying data to other areas in Eastern Botswana. The geomorphological situation, the nature of the covering layers, and the type of vegetation have to be taken into account when estimating groundwater recharge. (See also W89-08830) (Geiger-PTT)
W89-08851

RAINFALL-RUNOFF-RECHARGE RELATIONSHIPS IN THE BASEMENT ROCKS OF ZIMBABWE,
Hydrotechnica, Shrewsbury (England).
J. Houston.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 349-365, 12 fig, 3 tab, 13 ref.

Descriptors: *Recharge, *Base flow, *Surface-groundwater relations, *Groundwater recharge, *Zimbabwe, *Rainfall-runoff relationships, *Hydrologic models, Runoff, Rainfall, Boreholes, Simulation analysis, Chlorides, Evapotranspiration.

The resources of Basement aquifers in Victoria Province, Zimbabwe are largely dependent on rainfall recharge but no direct evidence for recharge in the form of borehole hydrographs is available. Estimates of recharge have been made by three methods: river baseflow analysis; hydrochemical analysis of groundwaters; and simulation modelling. During the baseflow studies, a regression analysis between baseflow and rainfall was carried out in catchments in Victoria Province. Chloride was used for a hydrochemical analysis of groundwater recharge, with the assumption that the ratio of chloride in rainfall to that in groundwater is proportional to recharge. To assess recharge by simulation analysis, a model was used which requires rainfall and evapotranspiration data as input and produces estimates of recharge and runoff as output. All three methods produce consistent results, suggesting that recharge amounts to between 2-5% of annual rainfall. Under such circumstances, which are widespread in Africa, it is essential to make resource estimates based on many years of data, otherwise over or under estimates are likely because of the considerable annual variation in rainfall. (See also W89-08830) (Geiger-PTT)
W89-08852

RECHARGE CHARACTERISTICS OF AQUIFERS OF JEDDAH-MAKKAH TAIF REGION,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrology.
Y. Basmaci, and M. Al-Kabir.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 367-375, 3 fig, 1 tab, 5 ref.

Descriptors: *Groundwater recharge, *Aquifers, *Groundwater movement, *Recharge, *Tracers, *Isotopic tracers, *Tritium, *Saudi Arabia, Deuterium, Oxygen, Rainfall, Evaporation, Regression analysis.

Recharge characteristics of the aquifers over the Jeddah-Makkah-Taif region of the Western Saudi Arabia were studied through environmental isotope techniques. Space and time variation of oxygen-18, deuterium and tritium in rainfall and in groundwater were analyzed. Variation of oxygen-18 with respect to the altitude in rain and groundwater are expressed as delta O18=-4h+b and delta O18=-1.4h-0.70 respectively. The intercept of the regression equation for rain samples varies in a range of -2 to 8o/oo O18 indicating seasonal changes and multitude of moisture sources in the area. The recharge area is the mountainous zone. Recharge is either direct or from the floods moving to the downstream reaches. (See also W89-08830) (Author's abstract)
W89-08853

GROUNDWATER RECHARGE AND SUBSURFACE FLOW IN THE COMODORO RIVADAVIA AREA, CHUBUT PROVINCE, ARGENTINA: ISOTOPIC AND HYDROCHEMICAL STUDY,
Instituto de Geocronologia y Geologia Isotopica, Buenos Aires (Argentina).
M. Levin, H. O. Panarello, M. C. Albero, E. Castrillo, and M. Grizinik.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 377-393, 5 fig, 2 tab, 6 ref.

Descriptors: *Groundwater recharge, *Groundwater movement, *Isotopic tracers, *Recharge, *Geochemistry, *Water chemistry, *Tracers, *Argentina, Chemical analysis, Deuterium, Tritium, Oxygen, Artificial recharge, Infiltration, Salinity.

Groundwater in the Comodoro Rivadavia area was studied using oxygen-18, deuterium, tritium and hydrochemical evolution. Stable isotopes in the multilayered system of the pampa table-lands define mainly an origin in locally melted snow with isotope composition significantly different from rain water over the lower eastern zones. Recharge has been defined as direct and autoctonous. Tritium contents suggest rather small recharge in comparison with the large volume stored in the reservoir. In the neighboring hill zone, where discharge occurs, springs and wells show isotopic evidence of local flow. In the interhill subunit, regional flow shows salinization and isotopic enrichment as a consequence of transit through marine facies and evaporation. In colluvial sediments groundwater exhibits higher tritium concentration, lower salinity and an isotope enrichment, due to direct infiltration of local surface water. Alloctonous to local recharge ratios can be estimated by the isotopic composition of the mixture. In the beach ridges, regional flow and artificial recharge of imported waters, carried by an aqueduct, was isotopically evident. (See also W89-08830) (Author's abstract)
W89-08854

GROUNDWATER RECHARGE OVER WESTERN SAUDI ARABIA,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
Y. Basmaci, and J. A. A. Hussein.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 395-403, 3 fig, 1 tab, 11 ref.

Descriptors: *Recharge, *Geomorphology, *Groundwater recharge, *Saudi Arabia, *Aquifers, *Semiarid lands, Rainfall, Infiltration, Alluvial fans, Alluvial aquifers, Groundwater movement.

Recharge characteristics of the groundwater aquifers over western Saudi Arabia were investigated. Recharge of aquifers is influenced by the geomorphology and basalt topography. The southern catchments have high yields because of high precipitation over the escarpment. Average yield of each aquifer is proportional to that part of the catchment in the semiarid zone. Recharge is directly from the rain over the outcropping rocks and the basalt plateau, and results from the floods in the alluvial aquifers. Floods are efficiently transferred into recharge through the alluvial fan over the foothill. The recharge of the northern catchments is comparable with the south although precipitation in the north is relatively low. Pediment zones intercept much of the runoff. (See also W89-08830) (Geiger-PTT)
W89-08855

NATURAL RECHARGE OF KARST AQUIFERS IN WESTERN TAURUS REGION (SOUTH-WESTERN TURKEY),
Hacettepe Univ., Ankara (Turkey). Dept. of Hydrogeological Engineering.
G. Gunay.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 405-422, 7 fig, 4 tab, 14 ref.

Descriptors: *Recharge, *Groundwater recharge, *Karst, *Aquifers, *Turkey, *Hydrologic budget, River basins, Geohydrology, Error analysis, Groundwater movement, Evaporation, Leakage, Precipitation, Runoff, Evapotranspiration.

In the Western Taurus region that extends between the Lake District and the Mediterranean Sea, South-western Turkey, some of the largest karst aquifers in the world are to be found. These are, from east to west, the karst aquifers of the Manavgat river basin, the Koprucay river basin, the Aksu river basin and karst aquifers of the travertines of the Antalya plateau and the Kirkgoz Springs. Computation of recharge and discharge of the aquifers was made by the water balance method during the intensive and detailed hydrogeological investigation of the relevant basins. The calculations revealed that a significant contribution, as natural recharge of the aquifers, comes from the adjacent basins. To reach a higher degree of accuracy, the sources of errors must be analyzed before interpretations are made. The natural recharge in the southwestern Taurus Mountains region reaches up to 1000 million cu m/yr. Construction of hydrogeotechnical projects must be planned taking into account both the natural recharge and the area that provides this excess water. (See also W89-08830) (Geiger-PTT)
W89-08856

ESTIMATION OF RECHARGE OF SAND AQUIFER OF THE ISLAND OF MANNAR, SRI LANKA,
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
D. C. H. Senarath.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 423-434, 3 fig, 1 tab, 10 ref.

Descriptors: *Groundwater recharge, *Sri Lanka, *Sand aquifers, *Recharge, *Hydrologic budget, Soil water, Precipitation, Evapotranspiration, Streamflow, Runoff, Hydrologic models.

An estimation of recharge to an aquifer can be carried out on the basis of water balance in which the top surface of the catchment and the soil moisture zone are taken into account. The data required are daily precipitation and potential evapotranspiration. The water balance can be verified on the basis of comparison of estimated streamflow with measured streamflow. The method was applied to estimate the recharge to a sand aquifer situated in the island of Mannar in northwest Sri Lanka. Soil moisture balance computations were carried out on a daily basis for the eleven year period from 1972 to 1982. The estimates of recharge obtained were confirmed by feeding these values to a flow model of the aquifer whose results can be verified by comparison with field data such as groundwater head distribution in space and time. The present method also gives monthly or daily values of recharge. (See also W89-08830) (Geiger-PTT)
W89-08857

GROUNDWATER RECHARGE FROM THREE CHEAP AND INDEPENDENT METHODS IN THE SMALL WATERSHEDS OF THE RAIN FOREST BELT OF NIGERIA,
Nigeria Univ., Nsukka. Dept. of Geology.
K. O. Uma, and B. C. E. Egboka.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 435-447, 2 fig, 4 tab, 10 ref.

Descriptors: *Recharge, *Groundwater recharge, *Nigeria, *Hydrologic budget, *Rain forests, Mathematical models, Rainfall, Aquifers, Base flow, Groundwater movement.

A study to evaluate critically and comparatively groundwater recharge into the small watersheds of the Imo River Basin, Nigeria, using three independent but inexpensive methods is discussed. The methods include: groundwater recharge using a simplified equation that relates groundwater stage to actual recharge with the aid of the aquifer porosity; recharge from baseflow recession analysis; and recharge from a water balance method. The results show that recharge values obtained from the water balance method were consistently higher than values from the other methods and ranged from 13.15% to 43.19% of the annual rainfall. Values obtained from baseflow recession analysis were consistently lower and ranged from 10.86% to 28.59%, while the values computed from the groundwater stage were moderate and ranged from 20.67% to 37.23% of the annual rainfall in the watersheds. The recharge values obtained from the groundwater stage appear very reasonable. However, the method is affected by the local relief of the monitoring station and it is necessary to monitor at as many stations as are possible to increase the reliability of the results. The recharge values obtained from the different methods show good correlation with one another. In the absence of groundwater stage data, recharge may be satisfactorily estimated as the mean of the values obtained from the baseflow recession analysis and the water balance methods. (See also W89-08830) (Author's abstract)
W89-08858

QUANTITATIVE ESTIMATION OF GROUNDWATER RECHARGE IN DOLOMITE,
Department of Water Affairs, Pretoria (South Africa).
D. B. Bredenkamp.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 449-460, 7 fig, 5 tab, 10 ref.

Descriptors: *South Africa, *Hydrologic budget, *Recharge, *Groundwater recharge, *Dolomite, Mathematical models, Rainfall, Groundwater movement, Model testing, Precipitation.

Quantitative estimation of annual recharge in the Bo Molopo dolomitic region (Western Transvaal) by means of the following equation, was demonstrated with a great measure of success: RE(I)=A(RF(I)-B), where RE(I) is the annual recharge and RF(I) the annual precipitation. B represents the threshold rainfall that is required to effect recharge and A is a lumped catchment parameter. Values for A (ranging from 0.28 to 0.35) and for B (ranging from 310 to 360) were obtained using reference recharge values that were determined from an interpretation of a sinkhole hydrograph and from water balance calculations. In checking the validity of the equation to estimate the average annual recharge, using the average annual rainfall in different dolomitic areas, the following relationship provided excellent results (correlation coefficient of 0.989): average annual recharge=0.30 average annual rainfall-313). The latter equation is regarded as the general relationship by which both annual and average recharge could be estimated for dolomitic regions in the summer rainfall areas of South Africa. (See also W89-08830) (Author's abstract)
W89-08859

QUANTITATIVE ESTIMATION OF GROUNDWATER RECHARGE IN THE PRETORIA-RIETONDALE AREA,
Department of Water Affairs, Pretoria (South Africa).
D. B. Bredenkamp.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 461-476, 5 fig, 7 tab, 3 ref.

Descriptors: *Recharge, *Hydrologic budget, *Groundwater recharge, *Test wells, *South Africa, *Soil porosity, Mathematical models, Aquifers, Rainfall, Isotopic tracers, Tritium.

Annual values of groundwater recharge expressed as an effective water-level rise were derived from an interpretation of the hydrographs of three monitoring boreholes. Independent estimates of the average annual recharge of the area were derived by means of the Darcy equation and by interpretations of natural tritium profiles in the soil overburden. The effective porosity of the aquifer was calculated from the average annual recharge (66 mm) and the average rise of the water was used to convert the annual equivalent water-level rises to a depth of precipitation. The latter were plotted against annual rainfall and indicated a linear relationship with annual rainfall in excess of a threshold value i.e. RE(I)=A(RF(I)-B), where RE(I) is the recharge and RF(I) the rainfall for year I. B is the threshold rainfall with an average value of 395 mm and the coefficient A is a lumped catchment parameter indicating the fraction of the excess annual rainfall that represents recharge. For the Rietondale area A is about 0.20 which implies that 20% of the excess rainfall constitutes recharge. The equation is similar to that obtained in the Bo Molopo dolomite area but in that case A is 0.30 and B is 313 mm. (See also W89-08830) (Author's abstract)
W89-08860

ANALYSIS OF LONG-DURATION PIEZOMETRIC RECORDS FROM BURKINA FASO USED TO DETERMINE AQUIFER RECHARGE,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
D. Thiery.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 477-489, 10 fig, 6 ref.

Descriptors: *Recharge, *Burkina Faso, *Hydrologic budget, *Groundwater recharge, *Test wells, *Hydrologic models, Piezometers, Granites, Rainfall, Evapotranspiration, Groundwater levels, Runoff.

An 8-year water-level record for an observation well in a granite environment in Ouagadougou (Burkina Faso) was analyzed using a lumped-parameter hydrological model. The model computes aquifer levels from rainfall and potential evapotranspiration data, and is calibrated with observed levels. Very satisfactory calibration is achieved, although aquifer levels have been dramatically declining since 1978. It appears that, even with small computational time-steps, a unique solution for calibration is only possible if the precise storage coefficient is known or if surface runoff data are available. In the absence of such data, multiple calibrations displaying the same agreement with observed data give different values for aquifer recharge, although relative variation is the same from year to year. When used in conjunction with a long set of in-situ rainfall records, however, the various sets of parameters applied result in almost-identical extension of water-level data, an important advance. The model shows that the 1978-1985 period is typified by the lowest water levels encountered in at least 60 years, and that a return to a rainfall sequence near the long-term average would cause the level to rise, although only after a period of 7 to 10 years. (See also W89-08830) (Author's abstract)
W89-08861

HUMID AND ARID ZONE GROUNDWATER RECHARGE-A COMPARATIVE ANALYSIS,
Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer Kulturteknik.
G. Knutsson.
IN: Estimation of Natural Groundwater Recharge. D. Reidel Publishing Company, Boston. 1988. p 493-504, 6 fig, 18 ref.

Descriptors: *Recharge, *Hydrologic budget, *Groundwater recharge, *Arid lands, *Arid climates, *Humid climates, *Evapotranspiration, Percolation, Unsaturated zone, Leaching, Weathering, Soil water, Groundwater movement, Comparison studies.

Humid climates, contrary to arid climates, are characterized by higher precipitation than evapotranspiration. This means that water balance methods for estimation of groundwater recharge are more useful in humid than in arid climates. Groundwater recharge in humid climates takes place more or less continuously by percolation in the unsaturated zone in the higher parts of the terrain and the water is discharged in the lower parts. This is contrary to the conditions in the arid climates, where the input of water is intermittent and the recharge is mainly localized to the lower parts of the terrain (river valleys, wadis) and rock outcrops. The unsaturated part of the ground with its vegetation is the crucial zone. The dominating water movement is downward in humid climates with leaching and weathering, contrary to in arid climates, where there is an upward transport and enrichment of salts. The methods for estimation of groundwater recharge based on soil water balance, or soil water flow are more important in humid than in arid climates. (See also W89-08830)
W89-08862

SYNTHESIS OF BOREHOLE GEOPHYSICAL DATA AT THE UNDERGROUND RESEARCH LABORATORY, MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W89-08980

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1986,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08981

GROUND-WATER-SURFACE WATER RELATIONS IN THE FLATHEAD RIVER VALLEY NEAR THE PROPOSED CABIN CREEK COAL MINE, BRITISH COLUMBIA, CANADA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08982

PRELIMINARY HYDROLOGIC DATA FOR WELLS TESTED IN NASH DRAW, NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
S. F. Richey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-37, 1987. 131p, 1 fig, 23 tab, 3 ref.

Descriptors: *Underground waste disposal, *Test wells, *Hydrologic data collections, *Waste disposal, *Site selection, *Pilot plants, New Mexico, Disposal sites, Water pressure, Hydrologic data, Hydrology, Flow profiles, Groundwater movement.

Hydrologic testing was conducted at wells WIPP-25, WIPP-26, WIPP-27, WIPP-28, WIPP-29, and WIPP-30 in Nash Draw near the Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested were the Magenta Dolomite Member of the Rustler Formation, Culebra Dolomite Member of the Rustler Formation, and the Rustler Formation-Salado Formation contact zone. Inflatable packers were used in a variety of test configurations. Tests conducted include bailing, recovery after perforation, shut in, slug, flow, and pressure pulse. Water pressure response in the tested zone was monitored by a pressure-transducer system. Preliminary hydrologic-test data are tabulated in chronological order for each well. (Lantz-PTT)
W89-08985

GEOLOGY OF THE DEVILS HOLE AREA, NEVADA,
Geological Survey, Reston, VA. Water Resources Div.
W. J. Carr.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-560, 1988. 32p, 4 fig, 7 ref, append.

Descriptors: *Geology, *Devils Hole, *Nevada, *Geohydrology, Aquifers, Springs, Groundwater movement, Limestone, Carbonate rocks, Geologic fractures.

Detailed and reconnaissance mapping of the Devils Hole, Nevada, area has improved definition of the local geologic structure within a regional carbonate aquifer near its primary discharge points -- the springs of Ash Meadows. Several formerly unmapped calcite veins, and other young calcite-lined paleo-spring feeder zones were found, as well as a number of previously unknown small collapse areas in the limestone. Although the predominant structural grain of the area is oriented northwest, the importance of the very subordinate northeast-striking faults and fractures is underscored by their association with Devils Hole itself, with most of the collapse depressions, and with many of the calcite veins in 'lake beds' and alluvium. Probable channeling of groundwater flow may occur along one important northeast-striking fault zone. The persistent tendency for openings may have been facilitated by underlying low-angle faults that separate brittle carbonate rocks from underlying, less-competent clastic rocks. (Author's abstract)
W89-08994

CHARACTER AND EVOLUTION OF THE GROUND-WATER FLOW SYSTEM IN THE CENTRAL PART OF THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
K. Belitz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-573, 1988. 34p, 24 fig, 30 ref.

Descriptors: *San Joaquin Valley, *Geohydrology, *Groundwater movement, *California, *Selenium, Agricultural runoff, Groundwater level, Aquifer systems, Groundwater irrigation, Percolation, Groundwater recharge, Potentiometric level.

The occurrence of selenium in agricultural drain water derived from the western San Joaquin Valley, California, has focused concern on the groundwater flow system of the western valley. Previous work and recently collected texture and water level data were used to evaluate the character and evolution of the regional groundwater flow system in the central part of the western valley, with particular emphasis on the deposits overlying the Corcoran Clay Member of the Tulane Formation. The Corcoran Clay Member, where present, divides the flow system into an upper semiconfined zone and a lower confined zone. Above the Corcoran, three geohydrologic units can be recognized: Coast Range alluvium, Sierran sand, and floodbasin deposits. These units differ in texture, hydrologic properties, and oxidation state. The development of irrigated agriculture in the central part of the western valley has significantly altered the flow system. Percolation of irrigation water past crop roots has caused a rise in the altitude of the water table in mid-fan and distal-fan areas. Pumpage of groundwater from wells has caused a lowering of the water table beneath parts of the fanheads and a lowering of the potentiometric surface of the confined zone over much of the western valley. The combination of percolation and pumpage has resulted in development of a large downward hydraulic head gradient in the semi-confined zone and has created a groundwater divide along the western margin of the valley. Surface water deliveries from the California Aqueduct have allowed a decrease in pumpage and a consequent recovery in hydraulic head throughout the system. (Author's abstract)
W89-08999

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
S. R. Anderson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-685, 1988. 3p, 9 fig, 55 ref.

Descriptors: *Subsidence, *Aquifers, *Groundwater depletion, *Land use, *Environmental effects, *Geologic fractures, *Arizona, Geohydrology, Water use, Groundwater recharge, Groundwater management, Agriculture.

Avra Valley is a large north-trending alluvial basin about 15 mi west of Tucson in Pima and Pinal Counties, Arizona. The climate of Avra Valley is semiarid, and the average annual precipitation ranges from 8 to 12 in. Two major ephemeral streams, the Santa Cruz River and Brawley Wash, drain the area. These streams and their tributaries provide a source of recharge to an extensive alluvial aquifer that underlies the valley floor. The aquifer consists of interbedded gravel, sand, silt, and clay and contains a vast quantity of groundwater. The physiography, fertile soil, and mild climate of Avra Valley make it an ideal environment for agriculture and urban development. Although the aquifer is replenished by natural recharge and underflow, rates of recharge and underflow have not kept pace with the rate of pumping. Pumping has exceeded recharge for several decades, resulting in a lowering of groundwater levels throughout most of the valley. In places, water level declines have resulted in small amounts of aquifer compaction and land subsidence. Earth fissures, some of which may be the result of localized differential subsidence, also have been observed in the valley. Geohydrologic characteristics of Avra Valley that may contribute to potential aquifer compaction, land subsidence, and earth fissures are described. The quantitative evaluation of potential land subsidence in this report is presented as an interim land- and water-use planning tool pending acquisition and study of additional data. Because of data limitations, the evaluation is made on the assumption that future rates of compaction and subsidence in Avra Valley will be similar to those in the Eloy-Picacho area. The evaluation also assumes that water level declines in the aquifer will continue. Several factors that may reduce groundwater withdrawals, and thus the potential for compaction and subsidence in Avra Valley, were not evaluated. These factors include the enactment of the 1980 Arizona Ground-Water Management Act, the planned importation of Colorado River water by the Central Arizona Project, the increased reuse and reclamation of effluent, and the probable long-term decrease in pumping by agricultural and some industrial users. (Lantz-PTT)
W89-09001

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, MAY 1987,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09003

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN EAST CARSON VALLEY, DOUGLAS COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. K. Maurer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-765, 1988. 6p, 2 tab, 5 plates, 3 ref.

Descriptors: *Model studies, *Simulation analysis, *Nevada, *Groundwater movement, *Pumping, Groundwater management, Groundwater depletion, East Carson Valley, Hydrologic models, Model studies, Groundwater budget, Groundwater level, Groundwater mining, Evapotranspiration, Surface-groundwater relations.

An existing groundwater model of Carson Valley was used to simulate changes in groundwater flow on the east side of Carson Valley, Nevada, in response to hypothetical increases in groundwater pumpage. Pumpage scenarios that reflect State groundwater permits and pending applications were used in four different simulations to estimate the effect of hypothetical development on groundwater levels and storage, groundwater flow to the Carson River, and groundwater levels and storage, groundwater flow to the Carson River, and groundwater consumed by evapotranspiration over a 45-yr period. The four simulations were based on pumpage rates ranging from 0.13 to 6.4 cu ft/sec (92 to 4,590 acre-ft/year). Changes in groundwater flow and water levels caused by the lowest rate were minimal and at the limit of accuracy of the groundwater model. The highest pumping rate caused water level declines as much as 15 ft, decreased groundwater storage by 27,000 acre/ft, decreased groundwater to the Carson River by 4.3 cu ft/sec (3,100 acre-ft/year), and reduced evapotranspiration losses by about 1,200 acre-ft/year. (Author's abstract)
W89-09004

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN SOUTHEASTERN CARSON CITY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. K. Maurer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-769, 1988. 7p, 1 fig, 1 tab, 6 plates, 5 ref.

Descriptors: *Simulation analysis, *Groundwater movement, *Pumping, *Model studies, *Groundwater management, Groundwater depletion, Nevada, Carson City, Hydrologic models, Model studies, Groundwater budget, Groundwater level, Groundwater mining.

An existing groundwater model was used to simulate changes in groundwater flow caused by hypothetical pumping in an area near the south-eastern part of Carson City, Nevada. A total of five hypothetical pumping patterns were used in the model simulations. The simulations assumed two pumping

rates: total annual average pumpage of 1,100 gal/min and 1,700 gal/min, which were assumed constant throughout the year. Simulations of the lesser quantity of pumpage did not induce significant losses from the Carson River to the aquifer after 50 years of simulation. The simulations indicate that a maximum of 140 gal/min (220 acre-ft/year) of induced flow from the Carson River could occur as a result of projected total pumpage of 1,700 gal/min after 10 years; the induced flow could increase 320 gal/min (520 acre-ft/year) after 50 years. However, river losses were projected to decrease to only 15 gal/min (25 acre-ft/year) after 10 years and 210 gal/min (340 acre-ft/year) after 50 years when the locations of the pumping centers were moved farther away from the river. (Author's abstract)
W89-09005

PREPROCESSOR AND POSTPROCESSOR COMPUTER PROGRAMS FOR A RADIAL-FLOW, FINITE-ELEMENT MODEL,
Geological Survey, Trenton, NJ. Water Resources Div.
A. A. Pucci, and D. A. Pope.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-680, 1987. 69p, 5 fig, 2 tab, 8 ref, 6 append.

Descriptors: *Groundwater movement, *Model studies, *Computer programs, *Finite element method, *Data interpretation, *Simulation analysis, Aquifers, Hydrologic models, Computer models.

Preprocessing and postprocessing computer programs that enhance the utility of the U.S. Geological Survey radial-flow model have been developed. The preprocessor program: (1) generates a triangular finite element mesh from minimal data input, (2) produces graphical displays and tabulations of data for the mesh, and (3) prepares an input data file to use with the radial-flow model. The postprocessor program is a version of the radial-flow model, which was modified to (1) produce graphical output for simulation and field results, (2) generate a statistic for comparing the simulation results with observed data, and (3) allow hydrologic properties to vary in the simulated region. Examples of the use of the processor programs for a hypothetical aquifer test are presented. Instructions for the data files, format instructions, and a listing of the preprocessor and postprocessor source codes are given in the appendixes. (Author's abstract)
W89-09007

INTRODUCTION TO GROUNDWATER HYDRAULICS--A PROGRAMMED TEXT FOR SELF-INSTRUCTION (INTRODUCCION A LA HIDRAULICA DE AGUAS SUBTERRANEAS),
For primary bibliographic entry see Field 8B.
W89-09010

PRINCIPLE OF SUPERPOSITION AND ITS APPLICATION IN GROUND-WATER HYDRAULICS,
For primary bibliographic entry see Field 7C.
W89-09011

HYDROLOGIC-HYDROCHEMICAL CHARACTERIZATION OF TEXAS GULF COAST SALINE FORMATIONS USED FOR DEEP-WELL INJECTION OF CHEMICAL WASTES,
Texas Univ. at Austin. Bureau of Economic Geology.
C. W. Kreitler, M. S. Akhter, and A. C. A. Donnelly.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242573. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/046, August 1988. 204p, 102 fig, 7 tab, 72 ref, append. Cooperative agreement CR-812786.

Descriptors: *Hydrologic data, *Hazardous waste disposal, *Frio formation, *Texas, Chemical wastes, *Deep well injection, *Groundwater movement, *Path of pollutants, Fate of pollutants, Groundwater recharge, Hydrocarbons, Saline water, Potentiometric level, Flow profiles, Oil fields, Organic compounds, Brine, Biodegradation.

Research was conducted to investigate fluid migration potential and fluid direction and velocities in the regional hydrologic environment of the Texas Gulf Coast Tertiary formations in the context of deep-well injection of hazardous chemical wastes. The study has focused on the Frio Formation because it is the target of massive waste injection and because a large database exists on formation pressures and water chemistry in the Frio. Pressure-depth profiles and potentiometric surfaces constructed from pressure data reflect existence of three hydrologic regimes: a shallow fresh to moderately saline water section in the upper 3,000-4,000 ft, an underlying 4,000- to 5,000-ft-thick, essentially saline hydrostatic section, and a deeper overpressured section with moderate to high salinities. The complexity of the hydrologic environment is enhanced by extensive depressurization in the 4,000- to 8,000-ft depth interval. Potentiometric surfaces representing discrete depth intervals were mapped. These values and the flow gradients determined from potentiometric surfaces and published permeability and porosity data were used to compute linear fluid flow velocities ranging from 0.01 ft/yr to 105 ft/yr in the lateral direction. Active recharge of Frio by continental waters does not appear to be occurring. All waters sampled appear to be in isotopic equilibrium with the rock matrix. In the northern section salt dome dissolution is the primary reaction controlling water chemistry in this region. Brines from the deeper geopressurized section may be leaking into the hydrostatic section of the central and southern Gulf Coast Frio. The lack of organic acids and the alteration of Frio oils from samples shallower than approximately 7,000 ft suggest biodegradation. This has a useful implication for degradation of injected chemical wastes. (Lantz-PTT)
W89-09012

FLUOROMETRIC PROCEDURES FOR DYE TRACING,
For primary bibliographic entry see Field 7B.
W89-09013

MODULAR THREE-DIMENSIONAL FINITE-DIFFERENCE GROUND-WATER FLOW MODEL,
M. G. McDonald, and A. W. Harbaugh.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Techniques of Water-Resources Investigations, Book 6: Modeling Techniques, Chapter A1, 1988. 576p, 56 fig, 2 tab, 10 ref, 5 append.

Descriptors: *Model studies, *Computer programs, *Finite difference method, *Groundwater movement, *Hydrologic models, Simulation analysis, Flow profiles, Computer models, Mathematical models, Mathematical equations.

A finite difference model simulates flow in three dimensions. Detailed explanations are given of physical and mathematical concepts on which the model is based and an explanation of how those concepts are incorporated in the modular structure of the computer program. The modular structure consists of a Main Program and a series of highly independent subroutines called 'modules.' The modules are grouped into 'packages.' Each package deals with a specific feature of the hydrologic system which is to be simulated, such as flow from rivers or flow into drains, or with a specific method of solving linear equations which describe the flow system, such as the Strongly Implicit Procedure of Slice-Successive Over-relaxation. The division of the program into modules permits the user to examine specific hydrologic features of the model independently. and facilitates development of additional capabilities because new packages can be added to the program without modifying the existing packages. The input and output systems of the computer program are also designed to permit maximum flexibility. Groundwater flow within the aquifer is simulated using a block-centered finite difference approach. Layers can be simulated as confined, unconfined, or a combination of confined and unconfined. Flow associated with external stresses, such as wells, areal recharge, evapotranspiration, drains, and streams, can also be simulated. The finite difference equations can be solved using either the Strongly Implicit Procedure or Slice-Successive Over-relaxation. The program is written in FORTRAN 77 and will run without modification on most computers that have a FORTRAN 77 compiler. For each program module, a narrative description, a flow chart, a list of variables, and a module listing are included. (Author's abstract)
W89-09015

GEOHYDROLOGIC FRAMEWORK OF THE COASTAL PLAIN AQUIFERS OF SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09016

POTENTIOMETRIC-SURFACE MAP OF THE WYODAK-ANDERSON COAL BED, POWDER RIVER STRUCTURAL BASIN, WYOMING, 1973-84,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09017

RECHARGE OF SHALLOW AQUIFERS THROUGH TWO EPHEMERAL-STREAM CHANNELS IN NORTHEASTERN WYOMING, 1982-83,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. W. Lenfest.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4311, 1987. 29p, 12 fig, 2 tab, 9 ref.

Descriptors: *Groundwater recharge, *Aquifers, *Wyoming, *Ephemeral streams, *Surface-groundwater relations, *Coal mining, *Powder River Basin, Alluvial aquifers, Environmental effects, Streamflow, Groundwater level, Stream discharge, Observation wells, Black Thunder Creek, Cheyenne River.

Quantifying the recharge from ephemeral streams to alluvial and bedrock aquifers will help evaluate the effects of surface mining on alluvial valley floors in Wyoming. Two stream reaches were chosen for study in the Powder River basin. One reach was located along the North Fork Dry Fork Cheyenne River near Glenrock, Wyoming, and the other reach was located along Black Thunder Creek near Hampshire, Wyoming. The reach along the North Fork Dry Fork Cheyenne River was instrumented with 3 gaging stations to measure streamflow and with 6 observation wells to measure groundwater level fluctuations in alluvial and bedrock aquifers in response to streamflow. The 3 streamflow gaging stations were located within the 2.5-mi study reach to measure the approximate gain or loss of discharge along the reach. Computed streamflow losses ranged from 0.43 acre-ft/mi on July 9, 1982, to 1.44 acre-ft/mi on August 9, 1982. The observation wells completed only in the alluvial aquifer were dry during flow in the North Fork Dry Fork Cheyenne River, whereas water levels in half of the observation wells completed in the bedrock aquifers or the alluvial and bedrock aquifers rose in response to flow in the North Fork Dry Fork Cheyenne River. Groundwater recharge on August 9, 1982, was calculated using a convolution technique using groundwater levels at the upstream site and was estimated to be 26.5 acre-ft/mi. The reach along Black Thunder Creek was instrumented with one gaging station to measure streamflow and with 4 observation wells to measure water level response in alluvial and bedrock aquifers to streamflow. Recharge to the alluvial aquifer from flow in Black Thunder Creek ranged from 3.56 to 12.4 acre-ft/mi. The recharge was estimated using the convolution technique using water level measurements in the observation wells

completed in the alluvial aquifer. Water level measurements in the observation wells indicated water level rises in the alluvial and bedrock aquifers in response to flow in Black Thunder Creek. (Author's abstract)
W89-09018

QUALITY OF GROUND WATER IN THE COLUMBIA BASIN, WASHINGTON, 1983,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09025

EXTENT AND SOURCE OF SALTWATER INTRUSION INTO THE ALLUVIAL AQUIFER NEAR BRINKLEY, ARKANSAS, 1984,
Geological Survey, Little Rock, AR. Water Resources Div.
E. E. Morris, and W. V. Bush.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4322, 1986. 123p, 14 fig, 3 tab, 41 ref, append.

Descriptors: *Groundwater pollution, *Alluvial aquifers, *Saline water intrusion, *Water pollution sources, *Arkansas, Groundwater quality, Sparta Aquifer, Groundwater movement.

An approximate area of 56 sq mi of the alluvial aquifer just north of Brinkley, Arkansas, has been contaminated by saltwater (chloride concentration > or = 50 mg/L) intruded from underlying aquifers. The contamination was mapped from water quality data for 217 wells. Saltwater problems appear to have spread rapidly in the alluvial aquifer since the late 1940's. Chemical comparisons indicate that the alluvial aquifer was contaminated by water from the Sparta aquifer which in turn was contaminated by the underlying Nacatoch aquifer. The possibility of intrusion into the alluvial aquifer through abandoned oil and gas test wells was investigated but no evidence could be found to support this possibility. Upward movement into the alluvial aquifer from the underlying Sparta aquifer through the thinned or absent Jackson confining unit appears to be the principal reason for saltwater in the alluvial aquifer. Increased withdrawals of water from the alluvial aquifer for irrigation and public supply appear to have contributed to this upward movement. (Author's abstract)
W89-09026

HYDROLOGIC EFFECTS OF ARTIFICIAL-RECHARGE EXPERIMENTS WITH RECLAIMED WATER AT EAST MEADOW, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-09027

PHYSICAL CHARACTERISTICS AND CHEMICAL QUALITY OF SELECTED SPRINGS IN PARTS OF JUAB, MILLARD, TOOELE, AND UTAH COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. E. Wilberg, and B. J. Stolp.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4324, 1985. 39p, 15 fig, 5 tab, 42 ref.

Descriptors: *Groundwater, *Water chemistry, *Water quality, *Hydrologic data collections, *Springs, *Utah, *Geohydrology, Chemical properties, Physical properties, Thermal springs, Groundwater recharge, Geohydrology, Discharge, Groundwater movement.

Hydrologic, geologic, and partial water quality data were collected at 90 selected springs in west-central Utah, and chemical analyses performed on water samples from 62 of the springs. Descriptions of the physiographic and geologic conditions, climate, and vegetation patterns for the study area are included. Allowable limits of certain chemical constituents in water for human and livestock consumption are included with the water quality data. Three classifications of springs were established based on physical characteristics of the springs, and chemical composition of the springflow: (1) mountain springs; (2) non-thermal valley springs, and (3) thermal valley springs. Mountain springs are in and near recharge areas, have seasonal variations of discharge and temperature, typically discharge from extrusive and metamorphic geohydrologic units, and generally discharge freshwater. Non-thermal valley springs are peripheral to recharge areas, have seasonal variations of discharge and temperature, typically discharge from a variety of geohydrologic units, and have variable water composition. Thermal valley springs are near topographic low areas of valleys, and have little seasonal variation of discharge or temperature. They typically discharge from unconsolidated deposits (but the discharge probably has flowed through buried carbonate geohydrologic units). They also have a considerable range of water composition that reflects the relative complexity of the groundwater system. (Author's abstract)
W89-09028

GROUND-WATER LEVELS AND DIRECTION OF GROUND-WATER FLOW IN THE CENTRAL PART OF BERNALILLO COUNTY, NEW MEXICO, SUMMER 1983,
Geological Survey, Albuquerque, NM. Water Resources Div.
G. Kues.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4325, 1986. 24p, 8 fig, 3 tab, 6 ref.

Descriptors: *Path of pollutants, *Hydrologic data collections, *Groundwater level, *Groundwater movement, *New Mexico, Rio Grande River, Wells, Flow profiles.

In 1980, toxic chemicals were detected in water samples from wells in and near Albuquerque's San Jose well field. At the request of the Environmental Improvement Division of the New Mexico Health and Environment Department, the U.S. Geological Survey conducted a study to determine groundwater levels and flow direction. Water levels were measured in 44 wells in a 64 sq mi area along the Rio Grande and adjacent areas during a period of near maximum municipal pumpage. Based on the altitude of screened interval, wells were grouped into shallow (screened internal above an altitude of 4,800 ft) or deep (screened internal below an altitude of 4,800 ft) zones. Groundwater in the shallow zone generally moves from north to south parallel to flow in the Rio Grande. Groundwater in the deep zone generally moves from the northwest to the east and southeast. A poorly developed cone of depression within the deep zone was present in the northeast. Water levels in wells were as much as 18 feet higher in the shallow zone than in the deep zone in the vicinity of the San Jose well field, indicating a downward gradient. (Author's abstract)
W89-09029

HYDROLOGIC CONDITIONS IN THE KLATT BOG AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09033

RESULTS OF EXPLORATORY DRILLING FOR WATER IN WAIHANAU VALLEY, MOLOKAI, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
K. J. Takasaki.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4332, 1986. 26p, 9 fig, 8 tab, 2 ref.

Descriptors: *Groundwater resources, *Pumping tests, *Exploration, *Drilling, *Water resources development, Hawaii, Molokai, Wells, Aquifers, Groundwater quality, Well yield, Perched aquifers, Water quality.

Three exploratory wells, located in lower Waihanau Valley on Molokai, were drilled and tested for their yields during the period May to October 1983. The first well, 582 ft deep, tapped the main water body in a basaltic aquifer intruded by scattered near-parallel volcanic dikes. Water in this water body is impounded by the dikes and has a head of about nine feet above sea level. A 48-hour pumping test was conducted on this well. The well was pumped at various rates ranging from 144 to 455 gal/min for nine hours. Thereafter, the well was pumped for 39 hours at a rate of 156 gal/min approximating the planned operational rate of 150 gal/min. The specific capacities of the well at the rates pumped averaged about 30 gal/min/ft of drawdown. The temperature of the pumped water remained nearly constant at 69 F (20.5 C). The chloride concentration ranged from 19 to 22 mg/L during the test. Analyses of the chemical constituents and trace metals of the water pumped indicated that it was of excellent quality. Based on these results, the well was finished as a production well. A shallow water body perched about 30 ft below ground surface and more than 400 ft above the main water body was discovered during the drilling of the first well when about 50 gal/min of water cascaded down the well. Two wells were drilled to depths of 200 and 150 ft, respectively, to explore this perched water. The yields obtained from this perched water body were low and indicated that its development was not feasible. (Author's abstract)
W89-09034

PROJECTED GROUND-WATER DEVELOPMENT, GROUND-WATER LEVELS, AND STREAM-AQUIFER LEAKAGE IN THE SOUTH FORK SOLOMON RIVER VALLEY BETWEEN WEBSTER RESERVOIR AND WACONDA LAKE, NORTH-CENTRAL KANSAS, 1979-2020,
Geological Survey, Lawrence, KS. Water Resources Div.
J. Kume, R. J. Lindgren, and L. E. Stullken.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4216, 1985. 42p, 11 fig, 10 tab, 1 plate, 6 ref.

Descriptors: *Surface-groundwater relations, *Kansas, *Model studies, *Groundwater budget, *Groundwater level, *Aquifers, *South Fork Solomon River, Groundwater management, Computer models, Pumpage, Alluvial aquifers, Seasonal variation.

A two-dimensional finite difference computer model was used to project changes in the potentiometric surface, saturated thickness, and stream aquifer leakage in an alluvial aquifer resulting from four instances of projected groundwater development. The alluvial aquifer occurs in the South Fork Solomon River valley between Webster Reservoir and Waconda Lake in north-central Kansas. In the first two projections, pumpage for irrigation was held constant at 1978 rates throughout the projection period (1979-2020). In the second two projections, the 1978 pumpage was progressively increased each yr through 2020. In the second and fourth projections, surface water diversions in the Osborne Irrigation Canal were decreased by 50%. For the third and fourth projections, each grid-block in the modeled area was classified initially as one of six types according to whether it represented irrigable or nonirrigable land, to its saturated thickness, to its location inside or outside the canal-river area, and to its pumping rate. The projected base-flow rates (leakage from the aquifer to the river) were lower during the irrigation season (June, July, and August) than during the other months of the yr because of the decline in hydraulic head produced by groundwater pumpage. Stream depletion, calculated as a decrease below the average (1970-78) estimated winter base-flow rate of 16.5 cu ft/sec, varied inversely with base flow. For the first two projections, a constant annual cycle of well pumpage and recharge was

used throughout the projection period. Aquifer leakage to the river was nearly constant by the mid-to-late 1990's, implying that flow conditions had attained a stabilized annual cycle. The third and fourth projections never attained an annual stabilized cycle because the irrigation pumpage rate was increased each year. By the early 1980's, the hydraulic head had fallen below river stage, reversing the hydraulic gradient at the stream-aquifer interface and resulting in net leakage from the river to the aquifer during the summer months. By the early 1990's, the projected potentiometric surface of the aquifer was lower than the river stage even during the winter and spring months. (Author's abstract)
W89-09036

ORGANIC COMPOUNDS IN GROUND WATER NEAR A SANITARY LANDFILL IN THE TOWN OF BROOKHAVEN, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09038

WATER RESOURCES IN BASIN-FILL DEPOSITS IN THE TULAROSA BASIN, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
B. R. Orr, and R. G. Myers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4219, 1986. 94p, 21 fig, 2 tab, 95 ref.

Descriptors: *Geohydrology, *Groundwater budget, *Tularosa Basin, *Groundwater quality, *Water resources data, *Data collections, *Water quality, *New Mexico, Saline water, Dissolved solids, Alluvial aquifers, Brine.

The Tularosa Basin, a faulted intermontane depression in south-central New Mexico, contains a thick sequence of alluvial and lacustrine deposits of Tertiary and Quaternary age. Most of these sediments are saturated with very saline water. Freshwater supplies (dissolved solids concentration < 1000 mg/L) principally are found in alluvial fans located around the basin margin. On the eastern side of the Tularosa Basin, fresh groundwater supplies are limited to alluvial fan deposits from Grapevine Canyon to about 3 mi south of Alamogordo. Data from surface geophysical surveys indicate that about 1.4 to 2.1 million acre-ft of freshwater may be in storage in this area, not all of which is recoverable. An additional 3.6 to 5.4 million acre-ft of slightly saline water (dissolved solids concentration 1000 to 3000 mg/L) may be in storage in the same area, again not all of which is recoverable. On the western side of the Tularosa Basin, alluvial fans in the vicinity of Rhodes Canyon may contain freshwater. Geophysical data indicate the freshwater zone may be as thick as 1500 ft in places; however, the limited number of wells in this area precludes a precise definition of the volume of freshwater in storage. To the south, freshwater is present in alluvial fans associated with the Ash Canyon drainage system. Geophysical data indicate that perhaps as much as 450,000 acre-ft of freshwater, not all recoverable, may be in storage in this area. Fan deposits between Ash Canyon and Rhodes canyon may contain additional freshwater supplies. Possibly 10.7 million acre-ft of freshwater, not all of which is recoverable, may be in storage on the western side of the Tularosa Basin. Possibly 180 million acre-ft of brine (concentrations of dissolved solids exceeding 35,000 mg/L), not all of which is recoverable, may be in storage in the Tularosa Basin. Information is sparse concerning the capability of saline aquifers in the Tularosa Basin to store and transmit fluid. (Author's abstract)
W89-09039

DISSOLVED CONSTITUENTS INCLUDING SELENIUM IN WATERS IN THE VICINITY OF KESTERSON NATIONAL WILDLIFE REFUGE AND THE WEST GRASSLAND, FRESNO AND MERCED COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
T. S. Presser, and I. Barnes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4220, August 1985. 73p, 7 fig, 11 tab, 60 ref.

Descriptors: *Path of pollutants, *California, *Water pollution sources, *Selenium, *Groundwater quality, *Kesterson National Wildlife Refuge, *Pollutant identification, Fate of pollutants, Wetlands, Bioaccumulation, Waterfowl.

Analyses were made for dissolved constituents including selenium (Se) in waters associated with subsurface agricultural drainage from the western San Joaquin Valley of California. In the vicinity of Kesterson National Wildlife Refuge and the Grassland wetlands area Se was found to be mobilized in water. As a consequence of this mobility and bioaccumulation in the aquatic food chain, Se occurred in waterfowl at levels toxic enough to cause deformities and deaths. Se concentrations in sumps that collect subsurface agricultural drainage water and inflows to drains sampled, ultimately leading into Kesterson National Wildlife Refuge and the Grassland, ranged from 84 to 4200 microgram/L (ug/L) Se. Levels of Se were reduced in the San Luis Drain flowing into Kesterson National Wildlife Refute to approximately 300 ug/L Se and in three of the drains sampled flowing into the Grassland to approximately 50 ug/L Se. Serious effects on water fowl habitat were caused by both these levels. Se contents of algal mats and salt crusts from evaporation ponds of the San Luis Drain contained up to parts per million Se. Total ecosystem assessment of Se may be necessary for the evaluation of the toxicity of Se to the environment. No other trace element reported exceeded the various criteria for water at the level of magnitude of Se. Other dissolved constituents and the isotopic ratios of oxygen and hydrogen were analyzed to elucidate water types, reaction states of the aqueous solution with respect to minerals, and the origin of mixed waters. These data will be used later to evaluate the geologic source of Se. Methods used for collection and analysis are described and documented. Hydrologic effects were found to be complex. Preliminary indications from wells are also given. A historical sequence is adhered to and other data from the study area which serve as a guide to the toxicity of Se are included. (Author's abstract)
W89-09040

GROUND-WATER FLOW IN MELTON VALLEY, OAK RIDGE RESERVATION, ROANE COUNTY, TENNESSEE--PRELIMINARY MODEL ANALYSIS,
Geological Survey, Nashville, TN. Water Resources Div.
P. Tucci.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4221, 1986. 20 p, 9 fig, 2 tab, 8 ref.

Descriptors: *Radioactive waste disposal, *Path of pollutants, *Groundwater movement, *Hydrologic models, *Tennessee, *Model studies, Roane County, Aquifers, Transmissivity, Precipitation, Groundwater recharge, Simulation analysis, Vertical flow, Regolith, Bedrock, Groundwater level, Clinche River.

Shallow land burial of low-level radioactive waste has been practiced since 1951 in Melton Valley. Groundwater flow modeling was used to better understand the geohydrology of the valley, and to provide a foundation for future contaminant transport modeling. The three-dimensional, finite difference model simulates the aquifer as a two layer system that represents the regolith and bedrock. Transmissivities, which were adjusted during model calibration, range from 8 to 16 sq ft/day for the regolith, and from 0.2 to 1.5 sq ft/day for bedrock. An anisotropy ratio of 1:3 for strike-normal to strike-parallel transmissivity values, in conjunction with recharge rate = 6% of precipitation that is uniformly distributed over the model area, produces the best match between simulated and observed water levels. Simulated water levels generally compare well to observed or estimated 1978 groundwater conditions. Simulated water levels for the regolith for 39 of 69 comparison points are within +/- 10 ft of average 1978 levels. Simulated vertical flow components are in the observed direction for 9 of 11 comparison points. Preliminary simulations indicate that nearly all groundwater flow is within the regolith and discharges to either the Clinch River or the White Oak Creek-Melton Branch drainage systems. Less than 3% of the flow is between the regolith and bedrock, and < 1% of total groundwater flow discharges to the Clinch River through bedrock. Additional data needed to refine and further calibrate the model, include: (1) quantity and areal distribution of recharge; (2) water levels in the regolith near the model boundaries and beyond the Clinch River; (3) water levels and aquifer characteristics for bedrock; and (4) additional surface water data. (Author's abstract)
W89-09041

HYDROGEOLOGY AND EFFECTS OF LANDFILLS ON GROUND-WATER QUALITY, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09042

HYDROGEOCHEMISTRY OF THE UPPER PART OF THE FORT UNION GROUP IN THE GASCOYNE LIGNITE STRIP-MINING AREA, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
R. L. Houghton, D. C. Thorstenson, D. W. Fisher, and G. H. Groenewold.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 84-131, 1984. 184p, 45 fig, 17 tab, 142 ref, 5 append.

Descriptors: *Geochemistry, *Environmental effects, *Coal mining, *Geohydrology, *North Dakota, Aquifers, Chemical reactions, Sulfates, Adsorption, Cation exchange, Groundwater quality.

Geohydrochemical investigations in the vicinity of the Gascoyne Mine in the Northern Great Plains lignite region were initiated in 1973 in response to public concern about the effects of lignite strip mining on the quantity and quality of shallow groundwater. The effect of increased mining on the geohydrologic system may approximate that which would result from mining an undisturbed system. Petrologic and mineralogic analyses indicated Bullion Creek strata in the Gascoyne study area were deposited in an integrated fluvial-deltaic system on the seaward end of a broad alluvial plain. The Harmon lignite bed was deposited when the rate of clastic deposition became less than that of basin subsidence. The Harmon lignite bed is a local aquifer supplying water to livestock and domestic wells in the Gascoyne area. The lignite aquifer is recharged mainly by local precipitation and discharges mainly to the underlying basal Bullion Creek-Slop aquifer which is confined by the lignite underclay. The sandstone aquifer is recharged by leakage from the overlying lignite aquifer. Because recharge to both aquifers is dominated by precipitation, the quality of shallow groundwaters is controlled mainly by chemical processes occurring in the unsaturated zone. Laboratory experiments with natural aquifer sediments and waters and equilibrium geochemical modeling indicate the controlling processes are: dissolution of soil gases generated by oxidation of organic compounds; oxidation of iron sulfide minerals; dissolution of carbonate minerals; precipitation and dissolution of gypsum; cation exchange on clay minerals and cation exchange and adsorption on lignitic materials in the unsaturated zone; and cation exchange, sulfate reduction, and calcite precipitation within the aquifer. Dewatering of the lignite aquifer within the mine to facilitate strip-

ping has produced a large cone of depression centered on the mine in the lignite aquifer and the underlying sandstone aquifer, with water levels declining at a rate of 2.5 ft/yr and in the sandstone aquifer by about 1.5 ft/yr. (Author's abstract)
W89-09043

HYDROLOGIC DATA ON THE PUEBLOS OF JEMEZ, ZIA, AND SANTA ANA, SANDOVAL COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
S. D. Craigg.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-460, 1984. 37p, 4 fig, 9 tab, 2 plates, 5 ref.

Descriptors: *Hydrologic data collections, *New Mexico, *Groundwater quality, Geohydrology, Wells, Springs, Streams, Water quality, Groundwater level.

This report presents currently available geohydrologic data on the Pueblos of Jemez, Zia, and Santa Ana. Data about the occurrence, quantity, and quality of water from wells, springs, and streams are presented in nine tables. Data are tabulated for 73 wells and 39 springs. Water quality analyses are presented for 26 wells and 19 springs. The location of data sites, water level altitudes for wells, land surface altitudes at springs, water quality data, and other information are shown on two plates. These data provide a base with which to better define the water resources of the three pueblos. (Author's abstract)
W89-09051

MOVEMENT AND FATE OF SOLUTES IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER, CAPE COD, MASSACHUSETTS: U.S. GEOLOGICAL SURVEY TOXIC WASTE GROUND-WATER CONTAMINATION PROGRAM.
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09052

DIGITAL MODELING OF SOLUTE TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09054

SEWAGE CONTAMINANTS IN GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09055

CLOSED-LOOP STRIPPING, COMBINED WITH CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY ANALYSIS TO DEFINE A SEMI-VOLATILE ORGANIC CONTAMINANT PLUME,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-09056

EVIDENCE OF MICROBIAL PROCESSES IN SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09057

MICROBIAL DISTRIBUTION AND HETEROTROPHIC UPTAKE IN A SEWAGE PLUME,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09058

PRELIMINARY STUDY OF DENITRIFICATION IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09059

WATER-RESOURCES STUDIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1983, TO JUNE 30, 1984,
Geological Survey, Salt Lake City, UT.
For primary bibliographic entry see Field 2E.
W89-09060

PRINCIPAL FACTS FOR GRAVITY STATIONS IN DIXIE, FAIRVIEW, AND STINGAREE VALLEYS, CHURCHILL AND PERSHING COUNTIES, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09061

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1983,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09071

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1983,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09072

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09079

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1981,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09080

GEOHYDROLOGIC DATA FOR TEST WELL USW H-5, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
C. B. Bentley, J. H. Robison, and R. W. Spengler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-853, 1983. 34p, 19 fig, 6 tab, 6 ref. Interagency agreement DE-AI08-78ET44802.

Descriptors: *Radioactive waste disposal, *Geohydrology, *Test wells, *Hydrologic data, *Nye County, *Nevada, *Site selection, Groundwater budget, Groundwater level, Groundwater quality, Monitoring, Wells, Waste disposal, Groundwater movement, Boreholes, Dissolved solids, Sodium, Bicarbonate.

Data on drilling operations, lithology, borehole geophysics, water level monitoring, core analysis, groundwater chemistry, pumping tests, and packer-injection tests are reported for test well USW H-5. The well is one of a series of test wells drilled in and near the southwestern part of the Nevada Test Site, Nye County, Nevada, in cooperation with the U.S. Department of Energy. These test wells are part of the Nevada Nuclear Waste Storage Investigations to identify suitable sites for storage of high-level radioactive wastes. Test well USW H-5 was drilled to a total depth of 1,219 m through volcanic rocks consisting mostly of ash-flow tuff. Depth of water in the well ranged between 703.8 and 707.2 m below land surface, at an approximate altitude of 704 m above sea level. Drawdown in the well exceeded 6 m after test pumping more than 3,000 min at a rate of 10 L/sec. Borehole flow surveys showed that about 90% of the water in the well is contributed by the zone between 707 and about 820 m below land surface. Two composite water samples collected after well completion contained 206 and 220 mg/L of dissolved solids. Sodium and bicarbonate were the predominant dissolved anion and cation. The concentration of dissolved silica was 48 mg/L in both samples, which is a relatively large concentration for most natural waters. (Author's abstract)
W89-09081

CHEMICAL COMPOSITION OF GROUND WATER AND THE LOCATIONS OF PERMEABLE ZONES IN THE YUCCA MOUNTAIN AREA, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
L. V. Benson, J. H. Robison, R. K. Blankennagel, and A. E. Ogard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-854, 1983. 19p, 12 fig, 1 tab, 7 ref. Interagency agreement DE-AI08-78ET44802.

Descriptors: *Nevada, *Radioactive waste disposal, *Site selection, *Chemical analysis, *Groundwater quality, *Permeability, *Yucca Mountain, Wells, Sodium, Bicarbonate, Groundwater movement, Isotopic tracers.

Ten wells in the Yucca Mountain area of southern Nevada have been sampled for chemical analysis. Samples were obtained during pumping of water from the entire well bore (composite sample) and in one instance by pumping water from a single isolated interval in well UE-25b number 1. Sodium is the most abundant cation and bicarbonate the most abundant anion in all water samples. Although the general chemical compositions of individual samples are similar, there are significant differences in uncorrected carbon-14 age and in inorganic and stable-isotope composition. Flow surveys of seven wells performed using iodine-131 as a tracer indicate that groundwater production is usually from one or more discrete zones of permeability. (Author's abstract)
W89-09082

GEOHYDROLOGIC DATA FOR TEST WELL UE-25B NUMBER 1, NEVADA TEST SITE, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
D. H. Lobmeyer, M. S. Whitfield, R. G. Lahoud, and L. Bruckheimer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-855, 1983. 48p, 28 fig, 5 tab, 3 ref. Interagency agreement DE-AI08-78ET44802.

Descriptors: *Radioactive waste disposal, *Yucca Mountain, *Geohydrology, *Hydrologic data, *Test wells, *Nevada, *Nye County, *Site selection, *Data collections, Radioactive wastes, Disposal sites, Site selection, Boreholes, Lithology, Groundwater quality.

Data were collected to determine the hydraulic characteristics of rocks penetrated in test well UE-25b number 1. This well is one of a series of test wells drilled in and near the southwestern part of the Nevada Test Site in a program conducted in cooperation with the U.S. Department of Energy. These investigations are part of the Nevada Nuclear Waste Storage Investigations to identify suitable sites for storage of high level radioactive wastes.

Data on drilling operations, lithology, core analyses, borehole geophysics, hydrologic monitoring, hydraulic testing, and groundwater chemistry for test well UE-25b number 1 are reported. (Author's abstract)
W89-09083

GEOHYDROLOGIC DATA FOR TEST WELL USW H-6 YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
R. W. Craig, R. L. Reed, and R. W. Spengler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-856, 1983. 35p, 18 fig, 6 tab, 8 ref. Interagency agreement DE-AI08-78ET44802.

Descriptors: *Radioactive waste disposal, *Yucca Mountain, *Geohydrology, *Hydrologic data, *Test wells, *Nevada, *Nye County, *Data collections, Radioactive wastes, Disposal sites, Site selection, Boreholes, Lithology, Groundwater quality.

The following data are presented for test well USW H-6: drilling operations, lithology, availability of borehole geophysical logs, water levels, future availability of core analyses, water chemistry, pumping tests, and packer-injection tests. The well is one of a series of test wells drilled in and near Yucca Mountain adjacent to the Nevada Test Site, Nye County, Nevada, in cooperation with the U.S. Department of Energy. These investigations are part of the Nevada Nuclear Waste Storage Investigations to identify suitable sites for underground storage of high-level radioactive wastes. Test well USW H-6 was drilled to a total depth of 1,220 m. Rocks penetrated are predominantly ash-flow tuffs. Lava was encountered from 877 to 1,126 m. The composite static water level is approximately 526 m below land surface. The well was pumped during two periods. Maximum drawdown was about 18 m after pumping for 4,822 min at 28 L/sec, and 12 m after pumping for 2,226 min at 27 L/sec. A borehole flow survey showed that 91% of the water withdrawn from the well came from the depth intervals from 616 to 631 m, and from 777 to 788 m. (Author's abstract)
W89-09084

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF ANDROSCOGGIN, CUMBERLAND, FRANKLIN, KENNEBEC, LINCOLN, OXFORD, SAGADAHOC, AND SOMERSET COUNTIES, MAINE: SAND AND GRAVEL AQUIFER MAPS 10, 11, 16, 17 AND 32,
Geological Survey, Augusta, ME. Water Resources Div.
D. H. Tepper, J. S. Williams, A. L. Tolman, and G. C. Prescott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-82a, 1985. 106p, 11 fig, 9 tab, 5 plates, 79 ref.

Descriptors: *Geohydrology, *Groundwater quality, *Sand aquifers, *Aquifers, *Maine, *Water quality, Gravel, Maps, Bedrock, Well yield, Groundwater budget, Water table, Calcium, Sodium, Bicarbonates, Iron, Manganese, Water pollution sources.

A reconnaissance level geohydrologic study was made of 2,408 sq mi in Androscoggin, Cumberland, Franklin, Kennebec, Lincoln, Oxford, Sagadahoc and Somerset Counties in Maine. This area is included in Maps 10, 11, 16, 17, and 32 of the Sand and Gravel Aquifer Map Series published by the Maine Geological Survey. The significant sand and gravel aquifers, defined as yielding 10 or more gal/min to a properly installed domestic well, consist of glacial ice-contact and outwash deposits which occur primarily in the valleys of the major rivers and along their tributaries. Significant aquifers comprise almost 109 sq mi, but yields that exceed 50 gal/min are estimated to be available within only 21% of this area. Typically, the water table is within 20 ft of the land surface. Based on seismic data, the greatest known depth to bedrock is 340 ft. The regional groundwater quality has the following characteristics: It is slightly acidic to slightly basic; calcium and sodium are the most abundant cations; bicarbonate is the most abundant anion; and the water is soft. In some localities concentrations of iron and manganese are high enough to limit use of the water without treatment. Sixty-six sites, including 32 solid waste facilities and 18 salt-storage lots were identified as potential sources of groundwater contamination to the sand and gravel aquifers in the study area. (Author's abstract)
W89-09085

OCCURRENCE OF URANIUM IN GROUND WATER IN THE VICINITY OF THE U.S. DEPARTMENT OF ENERGY FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09086

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEBRASKA, 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09087

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
W. D. Nichols.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-198, 1986. 85p, 32 fig, 17 tab, 1 plate, 38 ref.

Descriptors: *Soil water, *Groundwater pollution, *Geohydrology, *Aeration zone, *Waste disposal, *Site selection, *Radioactive waste disposal, *Beatty, *Nevada, *Path of pollutants, Soil water, Hydrologic budget, Precipitation, Soil water potential, Hydraulic conductivity, Evaporation, Percolation.

Low-level radioactive solid waste has been buried in trenches at a site near Beatty, Nevada, since 1962. In 1976, as part of a national program, the U.S. Geological Survey began a study of the geohydrology of the waste burial site to provide a basis for estimating the potential for radionuclide migration in the unsaturated zone beneath the waste burial trenches. Data collected include meteorological information for calibration of a long-term water budget analysis, soil moisture profiles, soil water potentials, and hydraulic properties of representative unsaturated sediment samples to a depth of about 10 m. The waste burial facility is in the northern Amargosa Desert about 170 km northwest of Las Vegas, NV. The region is arid; mean annual precipitation at Lathrop Wells, 30 km south of the site, is only 7.4 cm. The mean daily maximum temperature at Lathrop Wells in July, the hottest month, is 37 C. The site is underlain by poorly stratified deposits of gravelly or silty sand and sandy gravel, and thick beds of clayey sediments. The total thickness of valley fill deposits beneath the site is about 175 m; the unsaturated zone is about 85 m thick. Volumetric soil moisture to depths of 4 m ranges from 4% to 10%, but commonly is in the range from 6% to 8%. Soil water potential, measured to depths of 3 to 10 m, ranged from -10 to -70 bars. Unsaturated hydraulic conductivity computed from laboratory analyses of representative samples ranges from 10 to the -13th power to 10 to the -4th power cm/day. Evaporation studies over a 2-yr period were used to calibrate a numerical procedure for analyzing long-term precipitation data and estimating annual water budgets during the 15-yr period 1962-76. This analysis (1) demonstrated that a potential exists for deep percolation (> 2 m), despite high annual evaporation demands, and (2) provided predictions of the time of yr and the antecedent conditions which enhance the probability of deep percolation. Soil moisture profiles obtained monthly over an 18-mo period demonstrate that deep percolation does occur. Soil moisture conditions antecedent to an observed deep-percolation event, and the time of yr when the percolation occurred, support the interpretations based on long-term meteorological records. (Author's abstract)
W89-09088

MODEL ASSESSMENT FOR DELINEATING WELLHEAD PROTECTION AREAS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 5G.
W89-09090

WATER RESOURCES ACTIVITIES IN LOUISIANA DISTRICT FISCAL YEAR 1985,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09094

PRELIMINARY EVALUATION OF THE GEOHYDROLOGY AND WATER QUALITY OF THE GREENACRES LANDFILL AREA, SPOKANE COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, G. L. Turney, and R. C. Alvord.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-496, 1986. 41p, 4 fig, 2 tab, 18 ref.

Descriptors: *Groundwater quality, *Geohydrology, *Spokane, *Washington, *Path of pollutants, *Water pollution sources, *Waste disposal, *Groundwater pollution, Leachates, Landfills, Aquifers, Organic compounds, Trans-dichloroethene.

The Greenacres Landfill, located about 11 mi east of the city of Spokane, Washington, was used for the disposal of waste from 1951 to 1972. Materials in the landfill include household and industrial waste materials, and various hazardous wastes. In 1983 the landfill was designated by the U.S. EPA as a 'Superfund' site. The purposes of this investigation were to gather, describe, and interpret all the existing data concerning the hydrology and groundwater quality of the area surrounding the landfill, and to identify any additional data needed to describe the hydrology of the area. The quantity of water flow through the landfill as a result of precipitation on the landfill and in the drainage basin above the landfill probably ranges from 21,000 to 85,000 gal/day. This water movement may be creating a leachate and transporting some of the wastes out of the landfill. The plume would encompass an area where groundwater provides most of the water used for municipal, industrial, irrigation, and domestic purposes. Water quality analyses of water from numerous wells in the area which are open to the Spokane aquifer are available, but well 25/45-16K1 is the only well where groundwater contamination was consistently apparent. This well is only 500 ft from the landfill. Contamination of water in this well was indicated by high concentrations of dissolved mineral constituents and several organic compounds, including trans-dichloroethene (115 to 392 micrograms/L). Available data are insufficient to completely interpret the groundwater flow system near this well and the source of the contamination cannot be determined conclusively. While the existing data are adequate to provide background information, more data are needed to: (1) determine the source of contamination in well 25/45-16K1; (2) determine groundwater flow in the Spokane aquifer near well 25/45-16K1; and (3) determine the extent of contamination in the Spokane aquifer. The degree of the influence of the landfill on the Spokane aquifer cannot be determined with existing data. (Author's abstract)
W89-09098

POTENTIAL HYDROLOGIC EFFECTS OF GROUND-WATER WITHDRAWALS FROM THE DAKOTA AQUIFER, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-09100

GROUND-WATER AND SURFACE-WATER-LEVEL DATA AT RINDGE TRACT ON THE STOCKTON DEEP WATER SHIP CHANNEL, SAN JOAQUIN COUNTY, CALIFORNIA, 1983-84,
Geological Survey, Sacramento, CA. Water Resources Div.
K. L. Johnson, and M. J. Pierce.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-573, 1986. 1p, 6 fig, 7 ref.

Descriptors: *Surface-groundwater relations, *California, *Groundwater level, *Water level, *Dredging, *Stockton Deep Water Channel, Observation wells, Environmental effects, Tide lands.

The Sacramento-San Joaquin Delta is formed at the confluence of the two major rivers that drain the Central Valley of California. The Sacramento and San Joaquin Rivers and many interconnecting sloughs meandered back and forth across the tidelands, frequently overflowing their banks. Approximately 1,100 miles of levees were constructed to form about 60 tracts or islands that protect these lands from periodic flooding. The levees were constructed of sand, silt, and peat dredged from the channel bottom and are subject to erosion and failure. Owing to compaction, oxidation of the peat, and other related conditions, the islands are subsiding at rates of up to 0.25 ft/yr. The altitude of the land surface of the islands is often below sea level and below the surface water level in the channel. This condition causes stresses that may contribute to high groundwater levels and levee failure. The U.S. Army Corps of Engineers requested that the U.S. Geological Survey install and maintain continuous recorders to monitor water levels in each of four wells. Monitoring which began in July 1983 also provided data to show the relation between surface water levels in the channel and groundwater levels in the wells. Dredging began in the area of the Rindge Tract site during the latter part of July 1983. Water levels in all four wells dropped 1.5 to 2 ft between September 1983 and September 1984 and continued to drop thorough December 1984. (Lantz-PTT)
W89-09101

LEACHATE MIGRATION FROM AN IN SITU OIL-SHALE RETORT NEAR ROCK SPRINGS, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09102

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1985,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09104

WATER-TABLE DECLINE IN THE SOUTH-CENTRAL GREAT BASIN DURING THE QUATERNARY PERIOD: IMPLICATIONS FOR TOXIC-WASTE DISPOSAL,
Geological Survey, Richmond, VA. Water Resources Div.
I. J. Winograd, and B. J. Szabo.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-697, 1986. 18p, 1 fig, 1 tab, 26 ref.

Descriptors: *Paleohydrology, *Underground waste disposal, *Geohydrology, *Water table decline, *Nevada, *California, *Waste disposal, Groundwater discharge, Tectonics, Groundwater level, Aeration zone, Hydraulic gradient.

The distribution of vein calcite, tufa, and other features indicative of paleo-groundwater discharge, indicates that during the early to middle Pleistocene, the water table at Ash Meadows, in the Amargosa Desert, Nevada, and at Furnace Creek Wash, in east-central Death Valley, California, was tens to hundreds of meters above the modern water table, and that groundwater discharge occurred up to 18 km up-the-hydraulic gradient from modern discharge areas. Uranium series dating of the calcitic veins permits calculation of rates of apparent water table decline; rates of 0.02 to 0.08 m/1000 yr are indicated for Ash meadows and 0.2 to 0.6 m/1000 yr for Furnace Creek Wash. The rates for Furnace Creek Wash closely match a published estimate of vertical crustal offset for this area, suggesting that tectonism is a major cause for the displacement observed. In general, displacements of the paleo-water table probably reflect a combination of: (a) tectonic uplift of vein calcite and tufa, unaccompanied by a change in water table altitude; (b) decline in water table altitude in response to tectonic depression of areas adjacent to dated veins and associated tufa; (c) decline in water table altitude in response to increasing aridity caused by major uplift of the Sierra Nevada and Transverse Ranges during the Quaternary; and (d) decline in water altitude in response to erosion triggered by increasing aridity and/or tectonism. A synthesis of geohydrologic, neotectonic, and paleoclimatologic information with the vein-calcite data permits the inference that the water table in the south-central Great Basin progressively lowered throughout the Quaternary. This inference is pertinent to an evaluation of the utility of thick (200-600 m) unsaturated zones of the region for isolating solidified radioactive wastes from the hydrosphere for hundreds of millenia. Wastes buried a few tens to perhaps 100 m above the modern water table--that is above possible water level rises due to future pluvial climates--are unlikely to be inundated by a rising water table in the foreseeable geologic future. (Author's abstract)
W89-09107

PRELIMINARY REPORT ON GEOPHYSICAL WELL-LOGGING ACTIVITY ON THE SALTON SEA SCIENTIFIC DRILLING PROJECT, IMPERIAL VALLEY, CALIFORNIA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09114

ESTIMATION OF THE RECHARGE AREA CONTRIBUTING WATER TO A PUMPED WELL IN A GLACIAL-DRIFT, RIVER-VALLEY AQUIFER,
Geological Survey, Providence, RI. Water Resources Div.
D. J. Morrissey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-543, 1987. 60p, 31 fig, 4 tab, 51 ref.

Descriptors: *Recharge area, *Pump wells, *Glacial drift, *Model studies, *Aquifer characteristics, *Hydraulic conductivity, *Groundwater recharge, *Groundwater quality, *Glacial aquifers, *Mathematical models, Hydrologic models, Aquifers, Rivers, Land use, Water quality control, Pumping, Groundwater management, Estimating, Drinking water, Valleys.

The highly permeable, unconfined, glacial drift aquifers that occupy most New England river valleys constitute the principal source of drinking water for many communities that obtain part or all of their public water supply from groundwater. Analytical, two-dimensional numerical and three-dimensional numerical models were used to delineate contributing areas of groundwater pollution. These methods of analysis were compared by applying them to hypothetical aquifer having the dimensions and geometry of a typical glacial drift, river valley aquifer. In the model analyses, factors that control the size and shape of a contributing area were varied over ranges of values common to glacial drift aquifers in New England. These controlling factors include the rate of well discharge, rate of recharge to the aquifer from precipitation and from adjacent till and bedrock uplands, distance of a pumping well from a stream or other potential source of induced recharge, degree of hydraulic connection of the aquifer with a stream, horizontal hydraulic conductivity of the aquifer, ratio of horizontal to vertical hydraulic conductivity, and degree of well penetration. Numerical models of valley aquifers are deemed best suited to determine the approximate contributing area of a well because of their capability to simulate more accurately the variable geohydrologic conditions typical of glacial drift valley aquifers. On the basis of results obtained with the two-dimensional numerical model, for which a wide range of hydrologic conditions were simulated, the contributing area in a typical glacial drift, river valley setting for a well pumped at a rate of 1.0 million gal/day--a common pumping rate--can be expected to range from about 0.9 to 1.8 sq mi. Model analysis also shows that the contributing area of pumped wells may be expected to extend to the opposite side of the river and to include significant areas of till uplands adjacent to the aquifer on both sides of the valley. Simulations with the three-dimensional model allow a full delineation of the zone of contribution for a pumped well. For the relatively thin (100 ft or less) unconfined aquifers considered in this analysis, the model showed that the zone of contribution extended throughout the entire saturated thickness of aquifer. (Lantz-PTT)
W89-09115

DISTRIBUTION AND MOBILITY OF SELENIUM AND OTHER TRACE ELEMENTS IN SHALLOW GROUND WATER OF THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09116

DOCUMENTATION OF A DEEP PERCOLATION MODEL FOR ESTIMATING GROUNDWATER RECHARGE,
Geological Survey, Tacoma, WA. Water Resources Div.
H. H. Bauer, and J. J. Vaccaro.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-536, 1987. 180p, 13 fig, 2 tab, 19 ref, append.

Descriptors: *Computer programs, *Recharge, *Computer programs, *Documentation, *Percolation, *Groundwater recharge, *Model studies, Aquifers, Hydrologic models, Precipitation, Simulation analysis, Computer models, Soil water, Mathematical models, Air temperature, Soil properties, Estimating, Evaporation, Transpiration, Runoff, Snowmelt, Fortran.

A deep percolation model, which operates on a daily basis, was developed to estimate long-term average groundwater recharge from precipitation. It has been designed primarily to simulate recharge in large areas with variable weather, soils, and land uses, but it can also be used at any scale. The physical and mathematical concepts of the deep percolation model, its subroutines and data requirements, and input data sequence and formats are documented. The physical processes simulated are soil moisture accumulation, evaporation from bare soil, plant transpiration, surface water runoff, snow accumulation and melt, and accumulation and evaporation of intercepted precipitation. The minimum data sets for the operation of the model are daily values of precipitation and maximum and minimum air temperature, soil thickness and available water capacity, soil texture, and land use. Long-term average annual precipitation, actual daily stream discharge, monthly estimates of base flow, Soil Conservation Service surface runoff curve numbers, land surface altitude-slope-aspect, and temperature lapse rates are optional. The program is written in the FORTRAN 77 language

with no enhancements and should run on most computer systems without modifications. Documentation has been prepared so that program modifications may be made for inclusions of additional physical processes or deletion of ones not considered important. (Author's abstract)
W89-09117

AQUIFER-NOMENCLATURE GUIDELINES,
Geological Survey, Reston, VA. Water Resources Div.
R. L. Laney, and C. B. Davidson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-534, November 1986. 46p, 4 fig, 14 ref.

Descriptors: *Taxonomy, *Classification, *Aquifers, *Standards, *Geohydrology, Lithology, Stratigraphy, Geography, Aquifer characteristics.

Guidelines and recommendations for naming aquifers are presented to assist authors of geohydrological reports in the United States Geological Survey, Water Resources Division. The hierarchy of terms that is used for water- yielding rocks from largest to smallest is aquifer system, aquifer, and zone. If aquifers are named, the names should be derived from lithologic terms, rock-stratigraphic units, or geographic names. The following items are not recommended as sources of aquifer names: time-stratigraphic names, relative position, alphanumeric designations, depositional environment, depth of occurrence, acronyms, and hydrologic conditions. Confining units should not be named unless doing so clearly promotes understanding of a particular aquifer system. Sources of names for confining units are similar to those for aquifer names, i.e. lithologic terms, rock-stratigraphic units or geographic names. Examples of comparison charts and tables that are used to define the geohydrologic framework are included. Aquifers are defined in 11 hypothetical examples that characterize geohydrologic settings throughout the country. (Author's abstract)
W89-09118

SIMULATION OF FLOW IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS, AND REFINEMENT OF STORAGE AND FLOW CONCEPTS,
Geological Survey, Austin, TX. Water Resources Div.
R. W. Maclay, and L. F. Land.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-532, 1987. 86p, 23 fig, 7 tab, 92 ref.

Descriptors: *Groundwater storage, *Simulation analysis, *Model studies, *Groundwater movement, *Edwards Aquifer, *Storage coefficient, *Texas, Aquifers, Geohydrology, Groundwater recharge, Finite difference methods, Geologic fractures, Transmissivity, Anisotropy, Groundwater-surface relations, Groundwater barriers, Confined aquifers, Geological formations, Springs.

The Edwards aquifer is a complexly faulted, carbonate aquifer lying within the Balcones fault zone of south-central Texas. The aquifer is recharged mainly by streamflow losses in the outcrop area of the Edwards aquifer and is discharged by major springs located at considerable distances, as much as 150 mi, from the areas of recharge, and by wells. Groundwater flow within the Edwards aquifer of the San Antonio region was simulated to investigate concepts relating to the storage and flow characteristics. A general purpose, finite difference model, modified to provide the capability of representing barrier faults, was used to simulate groundwater flow and storage in the aquifer. The simulations investigated the effects of complex geologic structures and significant changes in transmissivity, anisotropy, and storage coefficient, with initial values based on concepts developed in previous studies. Results of the simulations confirmed the original estimates of transmissivity values (> 100 sq ft/sec) in the confined zone of the aquifer between San Antonio and Comal Springs. A storage coefficient of 0.05 in the unconfined zone of the aquifer produced the best simulation of water levels and springflow. A major interpretation resulting from the simulations is that two essentially independent areas of regional flow were identified in the west and central part of the study area. Flow from the two areas converges at Comal Springs. The directions of computed flux vectors reflected the presence of major barrier faults which locally deflect patterns of groundwater movement. The most noticeable deflection is the convergence of flow through the geologic structural opening, the Knippa gap, in eastern Uvalde County. A second significant interpretation is that groundwater flow in northeastern Bexar, Comal, and Hays Counties is diverted by barrier faults toward San Marcos Springs, a regional discharge point. (Lantz-PTT)
W89-09119

PLAN OF STUDY FOR THE REGIONAL AQUIFER SYSTEMS ANALYSIS OF THE MICHIGAN BASIN,
Geological Survey, Lansing, MI. Water Resources Div.
R. J. Mandle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-494, 1986. 23p, 6 fig, 26 ref.

Descriptors: *Aquifer characteristics, *Geologic formations, *Project planning, *Aquifer systems, *Groundwater budget, *Geohydrology, *Management planning, Groundwater movement, Michigan, Saline water intrusion, Groundwater management, Aquifers.

Quaternary glacial deposits and Pennsylvanian and Mississippian sandstones, -the Saginaw Formation and Marshall Sandstone--are the major aquifers in the Michigan basin. These aquifers supply approximately 188 million gal/day to municipalities in the 29,000 sq mi study area. The most significant problems related to groundwater supplies are the identification of potable sources of groundwater in large quantities and the migration of saline groundwater toward pumping centers. Saline water underlies the entire lower Peninsula of Michigan at indeterminate depth in the deeper parts of the Saginaw Formation and Marshall Sandstone in the center of the Michigan basin. In places, saline water is present in glacial deposits. Overdraft has resulted in severe drawdown in the Lansing area and the abandonment of wells near Flint because of saline water encroachment. Increased demand on the groundwater resources of the study area are expected to cause further problems. In 1985, the U.S. Geological Survey began a 5-yr study to define the geohydrologic framework, describe the geochemistry of groundwater in the glacial and bedrock aquifers, and analyze regional groundwater flow patterns. The scope, plan of study, organization and work elements are described in this report. (Author's abstract)
W89-09120

HYDROLOGIC MONITORING IN THE AREA OF THE TENNESSEE-TOMBIGBEE WATERWAY, MISSISSIPPI-ALABAMA FISCAL YEAR 1985,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09121

GEOHYDROLOGY OF AND POTENTIAL FOR FLUID DISPOSAL IN THE ARBUCKLE AQUIFER IN KANSAS, WITH A SECTION ON LOG ANALYSIS OF THE ARBUCKLE AQUIFER,
Geological Survey, Lawrence, KS. Water Resources Div.
J. E. Carr, H. E. McGovern, T. Gogel, and J. H. Doveton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open- File Report 86-491, 1986. 101p, 49 fig, 4 tab, 97 ref.

Descriptors: *Underground waste disposal, *Aquifers, *Aquifer characteristics, *Kansas, *Geohydrology, *Arbuckle Aquifer, *Path of pollutants, *Waste disposal, Brine, Aquifers, Groundwater pollution, Permeability, Transmissivity, Hydraulic conductivity, Model studies, Injection wells, Well logs, Well hydraulics, Geophysics.

The Arbuckle aquifer is an extensive aquifer that contains mostly saline water and that immediately overlies Precambrian 'basement' rocks throughout Kansas, except for major uplift areas where it has been removed by erosion. In the southeast part of the state, it is a major freshwater aquifer. The upper part of the Arbuckle contains significant oil and gas reservoirs in central and south-central Kansas. During the last 40 years the Arbuckle also has become the major zone of fluid disposal in the state. Most of the fluids disposed into the Arbuckle were produced from oil and gas wells in other formations. However, in recent years, state water agencies have become increasingly concerned about injection of fluids into the subsurface and the effects of injection on the hydrologic systems involved. An investigation of the geohydrology of the Arbuckle aquifer and of the hydrologic aspects of fluid disposal into the Arbuckle was conducted to evaluate these effects. Hydraulic characteristics obtained from drill stem tests, injection tests, and numerical modeling have indicated a range of permeability in the Arbuckle from 1 millidarcy to 30 darcys. Analysis of injection tests indicated that average permeability in the basin areas probably is in the 50-300 millidarcy range. Analyses of 76 geophysical logs indicate an average porosity of about 12%. An evaluation of the geohydrology of the Arbuckle shows that it is a large regional flow system that is in hydraulic connection with several other major aquifers. Groundwater flow within the Arbuckle is principally from the west-northwest to the east-southeast. Brine disposal in the Arbuckle has been increasing over the years. Rates of injection average about 60 gal/min. Model analysis, using aquifer properties similar to those expected in the basin areas and under selected conditions of well injection into the Arbuckle, indicates that, even with an injection rate of only 100 gal/min, pressure increases equivalent to fluid-level rises of up to 100 ft are expected as far as 500 ft away from the injection well. The model analysis indicates that the effects of transmission of fluid through the confining layer on overlying units are minor. (Lantz-PTT)
W89-09122

TWO-HUNDRED YEARS OF HYDROGEOLOGY IN THE UNITED STATES.
Geological Survey, Reston, VA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-480, 1986. 110 p, 27 fig, 2 tab. Edited by J. S. Rosenshein, J. E. Moore, S. W. Lohman, and E. B. Chase.

Descriptors: *History, *Geohydrology, Conferences, Water resources development, Quantitative analysis, Geophysics, Borehole geophysics, Water policy, Political aspects.

The Hydrogeology Division of the Geological Society of America (GSA) sponsored a symposium entitled 'Hydrogeology in the United States, 1776-1976' at the annual meeting of the GSA on November 9, 1976. The symposium was organized to provide a forum for discussion of major eras in the history of American hydrogeology and to contribute to the bicentennial celebration of the founding of the United States. Presentations were broken down into 3 sections: The Early Era (with a tribute to Oscar E. Meinzer), 1776-1920; Meinzer Era, 1910-1940; and the Modern Era (including scientific advantages; the quantification of hydrogeology; geochemistry; surface and borehole geophysics; and hydrogeology, policy, and politics) 1940-1976. (Lantz-PTT)
W89-09125

SOLUTE GEOCHEMISTRY OF THE SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
W. W. Wood, and W. H. Low.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-247, 1987. 146p, 30 fig, 27 tab, 132 ref.

Descriptors: *Regional Aquifer System Analysis, *Geochemistry, *Snake River Plain Regional Aquifer System, *Aquifer systems, *Idaho, *Oregon, Chemical reactions, Groundwater quality, Sodium, Chlorides, Bicarbonate, Silica, Fluorides, Sulfates, Arsenic, Boron, Lithium, Calcium, Magnesium.

Three geochemical methods were used to determine chemical reactions that control solute concentrations in the Snake River Plain regional aquifer system: (1) calculation of a regional solute balance within the aquifer and of mineralogy in the aquifer framework to identify solute reactions, (2) comparison of thermodynamic mineral saturation indices with plausible solute reactions, and (3) comparison of stable isotope ratios of the groundwater with those in the aquifer framework. The geothermal groundwater system underlying the main aquifer system was examined by calculating thermodynamic mineral saturation indices, stable isotope ratios of geothermal water, geothermometry, and radiocarbon dating. Water budgets, hydrologic arguments, and isotopic analyses for the eastern Snake River Plain aquifer system demonstrate that most, if not all, water is of local meteoric and not juvenile or formation origin. Solute balance, isotopic, mineralogic, and thermodynamic arguments suggest that about 20% of the solutes are derived from reactions with rocks forming the aquifer framework. Solute reactions indicate that calcite and silica are precipitated in the aquifer. Large amounts of sodium and chloride, relative to their concentration in the igneous rock, are being removed from the aquifer. Release of fluids from inclusions in the igneous rocks, and initial flushing of grain boundaries and pores of detrital marine sediments in interbeds are believed to be the source of the sodium chloride. Identification and quantification of reactions controlling solute concentrations in groundwater in the eastern plain indicate that the aquifer is not a large mixing vessel that simply stores and transmits water and solutes but is undergoing diagenesis and is both a source and sink for solutes. Reactions controlling solutes in the western Snake River basin are believed to be similar to those in the eastern basin but the regional geothermal system that underlies the Snake River Plain contains total dissolved solids similar to those in the overlying Snake River Plain aquifer system but contains higher concentrations of sodium, bicarbonate, silica, fluoride, sulfate, chloride, arsenic, boron, and lithium, and lower concentrations of calcium, magnesium, and hydrogen. (Lantz-PTT)
W89-09126

DATA ON THE SOLUTE CONCENTRATION WITHIN THE SUBSURFACE FLOWS OF LITTLE LOST MAN CREEK IN RESPONSE TO A TRANSPORT EXPERIMENT, REDWOOD NATIONAL PARK, NORTHWEST CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
G. W. Zellweger, V. C. Kennedy, K. E. Bencala, R. J. Avanzino, and A. P. Jackman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report OFR 86-403W, October 1986. 69p, 8 fig, 3 tab, 16 ref, 3 append.

Descriptors: *Water chemistry, *Tracers, *Surface-groundwater relations, *Solute transport, *Groundwater movement, Chlorides, Lithium, Potassium, Strontium, Groundwater pollution, Pore water, California.

A solute transport experiment was conducted on a 327-m reach of Little Lost Man Creek, a small stream in Humboldt County, California. Solutes were injected for 20 days. Chloride was used as a conservative tracer; lithium, potassium, and strontium were used as reactive tracers. In addition, nitrate and phosphate were added as biological reactants. Eighteen shallow wells were dug along the length of the study reach, 1-10 m laterally from the edge of the stream. The wells and sites in the stream were monitored for the injected solutes during and after the injection. Solute concentrations in the wells and stream are indicative of transport properties of stream and subsurface channel flow. This report presents the results of the analyses of the well samples and chemical data relevant to the interpretation of hydrological and chemical interaction between the stream and adjacent channel subsurface flows in the streambed. Calculations of the percentage of streamwater in the wellwater were made from conservative tracer measurements. The composition of wellwater ranged from 47% to 100% streamwater with most values above 90%. The time for water to travel from the beginning of the study reach to the wells was approximately three times as great as the travel time in the stream at the same distance down the reach. The three conclusions that can be drawn are (1) water in the stream exchanges extensively with water in the rest of the channel; (2) the interstitial water in the channel gravels achieves almost the same composition as the stream; and (3) under low flow conditions the stream gravels contain a significant portion of the stream volume. Plots of normalized chloride, lithium, and strontium concentrations at three stream sites are included. (Author's abstract)
W89-09130

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1985 THROUGH SEPTEMBER 1986,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09132

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1984 TO SPRING 1985.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09133

ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WATER-RESOURCES DIVISION IN NORTH CAROLINA, 1986,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09136

METHODS AND COMPUTER PROGRAM DOCUMENTATION FOR DETERMINING ANISOTROPIC TRANSMISSIVITY TENSOR COMPONENTS OF TWO-DIMENSIONAL GROUND-WATER FLOW,
Geological Survey, Doraville, GA. Water Resources Div.
M. L. Maslia, and R. B. Randolph.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-227, 1986. 64p, 8 fig, 2 tab, 19 ref, 5 append.

Descriptors: *Computer programs, *Anisotropy, *Transmissivity, *Groundwater movement, *Data interpretation, Least squares method, Mathematical studies, Geohydrology, Hydrologic properties, Flow profiles.

The theory of anisotropic aquifer hydraulic properties and a computer program, written in Fortran 77, developed to compute the components of the anisotropic transmissivity tensor of two-dimensional groundwater flow are described. To determine the tensor components using one pumping well and three observation wells, the type-curve and straight-line approximation methods are developed. These methods are based on the equation of drawdown developed for two-dimensional nonsteady flow in an infinite anisotropic aquifer. To determine tensor components using more than three observation wells, a weighted least squares optimization procedure is described for use with the type-curve and straight-line approximation methods. The computer program described in this report allows the type-curve, straight-line approximation, and weighted least squares optimization methods to be used in conjunction with data from observation and pumping wells. Three example applications using the computer program and field data gathered during geohydrologic investigations at a site near Dawsonville, Georgia, are provided to illustrate the use of the computer program. The example applications demonstrate the use of the type-curve method using three observation wells, the weighted least squares optimization method using eight observation wells and equal weighting, and the weighted least squares optimization method using eight observation wells and unequal weighting. Results obtained using the computer program indicate major transmissivity in the range of 347-296 sq ft/day, minor transmissivity in the range of 139-99 sq ft/day, aquifer anisotropy in the range of 3.54 to 2.14, principal direction of flow in the range of N. 45.9 degrees E. to N. 58.7 degrees E., and storage coefficient in the range of 0.0063 to 0.0037. The numerical results are in good agreement with field data gathered on the weathered crystalline rocks underlying the investigation site. Supplemental material provides definitions of variables, data requirements and corresponding formats, input data and output results for the example applications, and a listing of the Fortran 77 computer code. (Author's abstract)
W89-09137

CHEMICAL QUALITY OF GROUND WATER IN SALT LAKE VALLEY, UTAH, 1969-85,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09138

SELECTED HYDROLOGIC DATA FROM WELLS IN THE EAST SHORE AREA OF THE GREAT SALT LAKE, UTAH, 1985,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. G. Plantz, C. L. Appel, D. W. Clark, P. M. Lambert, and R. L. Puryear.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-139, 1986. 75p, 1 fig, 5 tab, 1 plate, 2 ref.

Descriptors: *Water resources data, *Water quality, *Hydrologic data collections, *Groundwater level, *Wells, *Groundwater quality, *Utah, Great Salt Lake, Drillers logs, Groundwater budget, Well yield.

This report contains hydrologic data for wells collected in the East Shore area of the Great Salt Lake, Utah. It includes water quality data, discharge measurements, water levels, and drillers logs. Most of the data in this report were collected from 1983 to 1985, and provide groundwater data for use by officials managing water resources and the general public and to supplement an interpretive report for the area that will be published later. Determinations can be made for the depth to water bearing units, water levels in wells, well yields, or chemical quality of groundwater at sites illustrated in this report. (Lantz-PTT)
W89-09139

WATER RESOURCES ACTIVITIES IN FLORIDA, 1985-86.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09140

SIMULATION OF FIVE GROUND-WATER WITHDRAWAL PROJECTIONS FOR THE BLACK MESA AREA, NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
J. G. Brown, and J. H. Eychaner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4000, February 1988. 51p, 24 fig, 3 tab, 11 ref.

Descriptors: *Hydrologic models, *Model studies, *Geohydrology, *Water resources development, *Simulation analysis, *Arizona, *Groundwater mining, *Groundwater management, Aquifers, Groundwater depletion, Groundwater level, Mathematical models.

The N Aquifer is the main source of water in the 5,400 sq mi Black Mesa area in the Navajo and Hopi Indian Reservations in northeastern Arizona. Water in the aquifer is under confined conditions in the central 3,300 sq mi of the area. Maximum saturated thickness is about 1,050 ft. Annual groundwater withdrawals from 1972 through 1986 averaged 5,480 acre-ft and included 3,820 acre-ft used to operate a coal mine on Black Mesa. As a result, water levels have declined in a large part of the aquifer. The coal company has applied for a permanent permit under the Surface Mining Control and Reclamation Act of 1977. An existing mathematical model of the aquifer in the Black Mesa area was converted to a newer model program and recalibrated by using revised estimates of selected aquifer parameters and a finer spatial grid. The model was used to simulate four groundwater withdrawal alternatives that combined the existing and proposed mining plans with projected constant or increasing pumpage for nearby communities. A fifth alternative combined increasing community pumpage with no mine withdrawals and was used as a basis for comparison. Simulated water levels for the year 2031 in the coal-lease area are projected to be 60 ft lower than in 1985 for the proposed mining plan combined with growing community pumpage and > 100 ft lower than predevelopment water levels over an area of 1,660 sq mi. Groundwater would rise to within 100 ft of predevelopment levels < 10 yr after mine withdrawals cease. Withdrawals at the mine were a minor factor in determining simulated water levels at most communities in the study area. Water levels at Tuba City were not affected by mine pumpage in any projection. (Author's abstract)
W89-09141

FRACTURE CHARACTERIZATION AND FRACTURE-PERMEABILITY ESTIMATION AT THE UNDERGROUND RESEARCH LABORATORY IN SOUTHEASTERN MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W89-09144

GEOHYDROLOGY OF THE NAVAJO SANDSTONE IN WESTERN KANE, SOUTHWESTERN GARFIELD, AND SOUTHEASTERN IRON COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4040, 1988. 43p, 6 fig, 7 tab, 2 plates, 36 ref.

Descriptors: *Water resources data, *Geohydrology, *Groundwater budget, *Utah, *Groundwater movement, Aquifers, Well logs, Navajo Sandstone, Groundwater recharge, Groundwater level.

The upper Navajo and Lamb Point aquifers in the Navajo Sandstone are the principal source of water for the city of Kanab, irrigation, stock, and for rural homes in the study area. Well logs and outcrop descriptions indicate the Navajo Sandstone consists of the Lamb Point Tongue and an unnamed upper member that are separated by the Tenney Canyon Tongue of the Kayenta Formation. The main Kayenta Formation underlies the Lamb Point Tongue. The Lamb Point Tongue and the upper member of the Navajo Sandstone are saturated and hydraulically connected through the Tenney Canyon Tongue. Available data indicate that precipitation percolates to the groundwater reservoir where the Navajo Sandstone crops out. Estimates of the rate of recharge at the outcrop range from 0.1 to as much as 2.8 in/yr. Water level data indicate that water moves from the upper member of the Navajo Sandstone, through the Tenney Canyon Tongue, and into the Lamb Point Tongue. Lateral flow is generally from the outcrop areas toward the incised canyons formed by tributaries of Kanab Creek and Johnson Wash. Direction and rate of groundwater movement and the location and character of the natural hydrologic boundaries in the northern part of the area where the Navajo Sandstone is buried cannot be determined conclusively without additional water level data. (Author's abstract)
W89-09146

CUMULATIVE POTENTIAL HYDROLOGIC IMPACTS OF SURFACE COAL MINING IN THE EASTERN POWDER RIVER STRUCTURAL BASIN, NORTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09147

WATER RESOURCES AND POTENTIAL EFFECTS OF SURFACE COAL MINING IN THE AREA OF THE WOODSON PREFERENCE RIGHT LEASE APPLICATION, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09148

AVAILABILITY OF GROUND WATER IN THE UNCONSOLIDATED AQUIFERS IN THE MID-HUDSON RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09149

MAP SHOWING OCCURRENCES OF SPRING-DEPOSITED TRAVERTINE IN THE CONTERMINOUS WESTERN UNITED STATES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7C.
W89-09150

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09151

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09152

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09153

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09154

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09155

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09156

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE, FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09157

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09158

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE, FOR CALENDAR YEAR 1986,
New Mexico State Engineer Office, Santa Fe.
For primary bibliographic entry see Field 7C.
W89-09159

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1986,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W89-09160

PRELIMINARY MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1984,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09161

PRELIMINARY MAP SHOWING THE DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE AQUIA AQUIFER OF SEPTEMBER 1982 AND SEPTEMBER 1984 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09162

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER OF SEPTEMBER 1982 AND SEPTEMBER 1984 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09163

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1984,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09164

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER, 1985,
Geological Survey, Towson, MD. Water Re-

sources Div.
For primary bibliographic entry see Field 7C.
W89-09165

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1985,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09166

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1986,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09167

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE AQUIA AQUIFER IN SPRING OF 1979 AND FALL OF 1986 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09168

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING FALL OF 1986,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09169

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER IN FALL OF 1975 AND FALL OF 1986 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09170

POTENTIOMETRIC SURFACE OF THE BISCAYNE AQUIFER NORTHWEST WELL FIELD DADE COUNTY, FLORIDA, MAY 24, 1984,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09171

POTENTIOMETRIC SURFACE OF THE BISCAYNE AQUIFER NORTHWEST WELL FIELD DADE COUNTY, FLORIDA, OCTOBER 16, 1984,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09172

GROUND-WATER HYDROLOGY OF THE MINOR TRIBUTARY BASINS OF THE OHIO RIVER, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
R. A. Shultz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. 1984. 1p, 8 fig, 4 tab, 27 ref.

Descriptors: *Groundwater budget, *Groundwater quality, *Maps, *Hydrologic data collections, *Ohio River, *Hydrologic maps, *West Virginia, Geohydrology, Chemical analysis, Well yield, Saline water.

One of a series of hydrologic atlases designed to aid the West Virginia Department of Natural Resources in delineating sources of potable groundwater needing protection under the U.S. EPA's underground injection control program is presented. The atlases summarize groundwater availability and quality by major river basins. The study area lies in the Appalachian Plateau's physiographic province and includes about 2,500 sq mi in West Virginia. Except for the Kanawha, Little Kanawha, Guyandotte, and Big Sandy River drainage areas, the minor tributaries to the Ohio River include all streams draining into the Ohio River from West Virginia between the State's boundaries with Kentucky and Pennsylvania. Highlights of this atlas include: availability of groundwater; general hydrology of mined and unmined areas; well yields; salty water; specific capacity; and chemical quality of the groundwater. (Lantz-PTT)
W89-09173

GROUND-WATER HYDROLOGY OF THE MINOR TRIBUTARY BASINS OF THE KANAWHA RIVER, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09174

COMPARISON OF IRRIGATION PUMPAGE WITH CHANGE IN GROUND-WATER STORAGE IN THE HIGH PLAINS AQUIFER IN CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA, 1975-83,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 3F.
W89-09175

GROUND-WATER RESOURCES OF THE LAURA AREA, MAJURO ATOLL, MARSHALL ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
S. N. Hamlin, and S. S. Anthony.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4047, 1987. 69p, 16 fig, 5 tab, 32 ref, 4 append.

Descriptors: *Water resources data, *Water resources development, *Groundwater budget, *Marshall Islands, *Atolls, Droughts, Wells, Groundwater level, Geohydrology, Permeability, Potable water, Groundwater recharge, Water supply, Saline water, Recharge.

The water system that supplies the heavily populated Dalap-Uliga-Darrit (DUD) area of Majuro atoll, Marshall Island, relies almost entirely upon airstrip catchment of rain water. Droughts cause severe water supply problems and water rationing is required, even during periods of normal rainfall. The Laura area contains a substantial lens of fresh groundwater that could be developed for export to the DUD area 30 mi to the east. Study of the groundwater resource at Laura involved a survey of existing wells, installation of monitoring wells and test holes, compilation of continuous records of rainfall and water level fluctuations, and collection of water quality data. Test hole data permitted the definition of three geohydrologic units which correlate well with similar units in Bikini and Enewetak atolls. The units consist of two layers of unconsolidated reef and lagoon sediments resting on a dense, highly permeable limestone. The potable water zone, or freshwater nucleus, of the lens is contained mostly within the unconsolidated layers, which are much less permeable than the basal limestone. Recharge to the Laura freshwater lens is estimated to be 1.8 mil gal/day, based on an average annual rainfall of 140 in. Sustainable yield is estimated to be about 400,000 gal/day. Shallow skimming wells or infiltration galleries similar to those used on Kwajalein atoll would be appropriate to develop the freshwater lens. The impact of development on the lens can be determined by monitoring the salinity in developed water and in a network of monitor wells. (Author's abstract)
W89-09176

QUALITY OF WATER FROM FRESHWATER AQUIFERS AND PRINCIPAL WELL FIELDS IN THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
J. V. Brahana, W. S. Parks, and M. W. Gaydos.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4052, 1987. 22p, 7 fig, 4 tab, 54 ref.

Descriptors: *Water resources data, *Aquifers, *Groundwater quality, *Wells, *Tennessee, Memphis, Groundwater depletion, Water use, Calcium bicarbonate, Sodium bicarbonate, Dissolved solids, Hardness, Iron, Water temperature, Minerals, Alkalinity, Sulfates, Chlorides, Irrigation, Industrial water, Municipal water.

Water from the freshwater aquifers in the Memphis area is suitable for most uses. Freshwater aquifers are the alluvium and fluvial (terrace) deposits of Quaternary age, the Memphis Sand and Fort Pillow Sand of Tertiary age, and the Ripley Formation and McNairy Sand of Cretaceous age. About 180 million gallons/day (mgd) of freshwater are withdrawn from the Memphis Sand, primarily for municipal and industrial use; the Memphis Sand is the principal aquifer supplying the City of Memphis. The alluvium provides water for irrigation and some industrial uses, and the fluvial deposits provide water for domestic use in rural areas. The Fort Pillow Sand supplies water for some municipal and industrial uses. The Ripley-McNairy aquifer is not used as a source of water. Water from the alluvium, fluvial deposits, and Memphis Sand is a calcium bicarbonate type, and water from the Fort Pillow Sand and Ripley-McNairy aquifer is a sodium bicarbonate type. Dissolved solids concentrations are low in the Memphis Sand, with a median value of 83 mg/L, and are high in the Ripley-McNairy aquifer with a value of about 1,000 mg/L. Water is very soft in the Fort Pillow Sand with a median hardness value of 9 mg/L as CaCO3 and is very hard in the alluvium with a median value of 285 mg/L. Iron concentrations are low in the fluvial deposits with a median value of 50 micrograms/L and are high in the alluvium with a median value of 5,200 micrograms/L. Temperature of the water generally increases with depth, ranging from 16.0 C in the alluvium and fluvial deposits to about 32.0 C in the Ripley-McNairy aquifer. Water from the Memphis Sand at Memphis Light, Gas and Water Division well fields has very low mineralization. Median values are 79 mg/L dissolved solids concentrations, 56 mg/L alkalinity as CaCO3, 46 mg/L hardness as CaCO3, 4 mg/L chloride, 3.5 mg/L sulfate, and 600 micrograms/L iron. (Author's abstract)
W89-09178

SIMULATION OF THE REGIONAL GEOHYDROLOGY OF THE TESUQUE AQUIFER SYSTEM NEAR SANTA FE, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. P. McAda, and M. Wasiolek.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4056, 1988. 71p, 24 fig, 12 tab, 44 ref.

Descriptors: *New Mexico, *Model studies, *Simulation analysis, *Geohydrology, *Tesque Aquifer, *Model studies, *Groundwater movement, Santa Fe, Aquifer systems, Groundwater level, Groundwater depletion, Flow profiles, Groundwater budget, Hydraulic conductivity, Specific yield, Anisotropy, Surface-groundwater relations, Groundwater storage.

Declining groundwater levels resulting from groundwater withdrawals in the Santa Fe, New Mexico, area have caused concern about the future availability of water from the Tesuque aquifer system (includes the Tesuque, Puye, and Ancha Formations of Tertiary age). The geohydrology of the Tesuque aquifer system in the Santa Fe area is described and a three-dimensional regional groundwater flow model is presented with which the effects of existing and possible future groundwater withdrawals on the regional aquifer system were assessed. The model was calibrated using simulations of the predevelopment steady-state condition and the 1947-82 historical period. The response of

the aquifer to two scenarios of future groundwater withdrawals from 1983 to 2020 was simulated. The maximum projected decline in hydraulic head from 1983 to 2020 was 174 ft for both the large and small water demand scenarios and occurred in the area of the Santa Fe well field. Simulated discharge to the Pojoaque River and its tributaries was 7.0 cu ft/sec at the end of the simulation with the small water demand and 6.9 cu ft/sec with the large water demand, compared to 7.3 cu ft/sec for the steady-state simulation and 7.1 cu ft/sec at the end of the historical transient simulation. The sensitivity of the model to changes in aquifer thickness, hydraulic conductivity, specific yield, storage coefficient, and vertical anisotropy ratio was tested. The sensitivity analyses indicated that maximum simulated decline in hydraulic head is most sensitive to specific yield. Average change in hydraulic head is most sensitive to hydraulic conductivity. Simulated discharge to the rivers is most sensitive to the changes in hydraulic conductivity. (Author's abstract)
W89-09181

AQMAN: LINEAR AND QUADRATIC PROGRAMMING MATRIX GENERATOR USING TWO-DIMENSIONAL GROUND-WATER FLOW SIMULATION FOR AQUIFER MANAGEMENT MODELING,
Geological Survey, Menlo Park, CA. Water Resources Div.
L. J. Lefkoff, and S. M. Gorelick.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4061, 1987. 164p, 10 fig, 1 tab, 28 ref, 5 append.

Descriptors: *Computer programs, *Groundwater movement, *Groundwater management, *Mathematical models, *Model studies, *Simulation analysis, Aquifers, Hydraulic models, Mathematical studies, Pumping, Groundwater recharge, Groundwater movement.

A FORTRAN-77 computer program code that helps solve a variety of aquifer management problems involving the control of groundwater hydraulics. It is intended for use with any standard mathematical programming package that uses Mathematical Programming System input format. The computer program creates the input files to be used by the optimization program. These files contain all the hydrologic information and management objectives needed to solve the management problem. Used in conjunction with a mathematical programming code, the computer program identifies the pumping or recharge strategy that achieves a user's management objective while maintaining groundwater hydraulic conditions within desired limits. The objective may be linear or quadratic, and may involve the minimization of pumping and recharge rates or of variable pumping costs. The problem may contain constraints on groundwater heads, gradients, and velocities for a complex, transient hydrologic system. Linear superposition of solutions to the transient, two-dimensional groundwater flow equation is used by the computer program in conjunction with the response matrix optimization method. A unit stress is applied at each decision well and transient responses at all control locations are computed using a modified version of the U.S. Geological Survey two dimensional aquifer simulation model. The program also computes discounted cost coefficients for the objective function and accounts for transient aquifer conditions. (Author's abstract)
W89-09183

SIMULATED EFFECTS OF GROUND-WATER MANAGEMENT ALTERNATIVES FOR THE SALINAS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-09186

WATER RESOURCES OF SOUTHEASTERN OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
K. J. Takasaki, and J. F. Mink.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 82-628, November 1982. 89p, 31 fig, 10 tab, 28 ref.

Descriptors: *Groundwater management, *Water resources development, *Oahu, *Hawaii, *Geohydrology, Groundwater movement, Groundwater budget, Saline water, Recharge.

Southeastern Oahu comprises the eastern end of the Koolau Range and is divided into two roughly equal parts by the crest of the range. The northside of the crest is commonly called the windward side and the southside, the leeward. The main Koolau fissure zone, including the caldera, lies on the windward side. The leeward side includes minor rift zones that are perpendicular to and intersect the main fissure zone. Water use is about 18 million gallons per day (mgd) of which only 4 mgd is obtained locally from groundwater sources. About a third of the 14 mgd deficit is imported from sources northwest of the study area on the windward side and the remainder from sources in the Honolulu and Pearl Harbor areas on the leeward side. Most fresh groundwater occurs in lava flows of the Koolau Volcanics. It is impounded by dikes in the rift zones and floats on saline groundwater as lenses outside the rift zones. Small but important bodies of freshwater are perched in volcanic rocks of the Honolulu Group in Manuawili Valley. Wells tapping saline groundwater in fresh lava flows of the Honolulu Group provide water for a sea-life park in the Makapuu area. The same aquifer is tapped by wells for disposal of the saline wastewater. The current development scheme in the windward side that utilizes only the free-flow equilibrium discharge of dike-impounded water is inefficient and does not cope with the annual weather cycle. The flow available for development under this scheme is greatest in the rainy winter months when demand is the lowest and least in the summer months when demand is the highest. A more optimal scheme would be to change this natural flow pattern by depleting storage by pumping to increase flow in the high-demand summer months and allowing the depleted storage to recover naturally in the low-demand winter months. (Lantz-PTT)
W89-09187

HYDROLOGY OF AREA 58, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09188

HYDROLOGY OF AREA 39, WESTERN REGION, INTERIOR COAL PROVINCE KANSAS AND MISSOURI,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09189

MOVEMENT AND FATE OF ETHYLENE DIBROMIDE (EDB) IN GROUND WATER IN SEMINOLE COUNTY, GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09190

GEOHYDROLOGY AND SUSCEPTIBILITY OF COLDWATER SPRING AND JACKSONVILLE FAULT AREAS TO SURFACE CONTAMINATION IN CALHOUN COUNTY, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
J. C. Scott, W. F. Harris, and R. H. Cobb.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4031, 1987. 29p, 3 fig, 1 tab, 1 plate, 17 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Groundwater pollution, *Springs, Alabama, Aquifers, Potentiometric level, Groundwater recharge, Maps, Recharge.

Coldwater Spring is the primary source of water supply for the city of Anniston, Fort McClellan, Anniston Ordinance Depot, and several smaller towns and suburban areas in the Anniston area, Calhoun County, Alabama. The total estimated population served by the spring is about 70,000. The spring is one of the largest in Alabama, having an average discharge of 31.2 million gallons per day (mgd). The Coldwater Spring aquifer system consists of fractured limestone, dolomite, and quartzite of Cambrian and Ordovician ages. The potentiometric surface map of the study area indicates that the recharge area for the aquifer system that supplies Coldwater Spring consists of about 23 sq mi, however, unit recharge values of over 20 in/yr appear to be unrealistic. Base flow (dry weather) data for streams indicate that a recharge area of about 90 sq mi is needed to support the average discharge of 31.2 mgd for the spring. Additional recharge may be derived from outside the recharge area delineated from the potentiometric map because the limited number and shallow depth of most wells may not accurately define the potentiometric surface. Movement of groundwater to the spring may be occurring along the Jacksonville Fault but cannot be defined because of the limitations of the available data. On the basis of a recharge area of 90 sq mi, groundwater protection measures should be extended from Coldwater Spring northeastward to the town of Jacksonville. The parts of the recharge area that are most susceptible to contamination from the surface are the flat to gently rolling terrains underlain by limestone, dolomite, and quartzite. About three-fourths of the recharge area depicted by the potentiometric map appears to be susceptible to contamination from the surface. (Lantz-PTT)
W89-09191

COMPARISON OF IRRIGATION PUMPAGE AND CHANGE IN WATER STORAGE OF THE HIGH PLAINS AQUIFER IN CASTRO AND PARMER COUNTIES, TEXAS, 1975-83,
Geological Survey, Austin, TX. Water Resources Div.
G. W. Mackey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4032, 1987. 48p, 13 fig, 10 tab, 50 ref.

Descriptors: *Recharge, *Groundwater irrigation, *Groundwater management, *High Plains Aquifer, *Groundwater depletion, *Groundwater storage, *Texas, *Irrigation, Groundwater budget, Water use, Aquifers, Specific yield, Groundwater level, Groundwater recharge.

An understanding of the relationship between irrigation pumpage and change in groundwater storage was needed to quantify the amount of water returning to the High Plains aquifer as a result of intensive irrigation in Castro and Parmer Counties, Texas. Irrigation pumpage for the 9-yr period, 1975-83, was estimated by using the Blaney-Criddle consumptive-use formula adjusted by a factor to account for irrigation demand and field-measured crop applications. Total estimated pumpage for the 9-yr period was 11,269,000 acre-ft and 8,914,000 acre-ft. The estimated pumpage was based on reported crop acreage data and LANDSAT acreage data, respectively. Aquifer storage for the same period was estimated as the product of specific yield, net water level change, and area. Change in storage was 5,168,00 acre-ft. Many of the areas of the largest change in storage also were the areas of the largest saturated thickness. The only locations that did not experience substantial water level declines were the northwest and northeast parts of the study area. A comparison was made of water returning to the aquifer by calculating the difference between irrigation pumpage and the change in aquifer storage. Two estimates of this comparison, expressed as a percentage of irrigation pumpage, were obtained on the basis of two different sources of acreage data. This comparison was 54% of pumpage based on reported crop acreage data and 42% of pumpage based on

LANDSAT interpreted acreage data. (Author's abstract)
W89-09192

POTENTIAL WELL YIELDS FROM UNCONSOLIDATED DEPOSITS IN THE LOWER HUDSON AND DELAWARE RIVER BASINS, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09195

DATA FOR GROUND-WATER TEST HOLES IN FRESNO COUNTY, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA, JUNE TO AUGUST 1985,
Geological Survey, Sacramento, CA. Water Resources Div.
S. Beard, and J. Laudon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-78, 1988. 39p, 3 fig, 3 tab, 6 ref.

Descriptors: *Selenium, *Groundwater quality, *Hydraulic properties, *Geochemistry, *Test holes, *San Joaquin Valley, *California, Hydrologic properties, Geophysics, Groundwater level, Lithologic logs, Geophysical logs.

Twenty-four test holes were drilled from June 3 to August 29, 1985, in the western San Joaquin Valley, California, to provide information about groundwater hydraulics and geochemistry. The study area is in western Fresno County, west of the San Joaquin River, and east of the Coast Range. Lithologic, hydrologic, and geophysical data were collected from test holes drilled at two cluster sites and at 13 additional sites. Both cluster sites have five cased test holes. A sixth test hole was drilled at one of the cluster sites but was destroyed. Each of the 10 cased test holes is perforated at a different 10-ft depth interval. Six of the 13 additional test holes were also cased. Lithology logs were constructed from descriptions of cuttings and cores recovered during drilling. Geophysical logs were made of the deepest hole at each cluster site. Initial water level measurements were made at most sites. (Author's abstract)
W89-09197

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT, IN THE 1987 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09206

U. S. GEOLOGICAL SURVEY GROUNDWATER STUDIES IN FLORIDA,
Geological Survey, Reston, VA. Water Resources Div.
J. Vecchioli.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-107, 1988. 2p, 1 fig, 6 ref.

Descriptors: *Groundwater quality, *Groundwater management, *Project planning, *Florida, Saline water intrusion, Groundwater budget, Waste disposal, Landfills, Water pollution sources, Groundwater pollution, Agriculture.

The first groundwater study by the U.S. Geological Survey (USGS) in Florida began in 1910. In 1930, a cooperative program of study was started with the Florida Geological Survey, and in 1938, the first groundwater office of the USGS was established in Miami. In fiscal year 1987, the USGS program in Florida included 35 active groundwater studies, all of which dealt with at least one of the principal groundwater issues. The 35 active studies were divided among the issues as follows: groundwater quality management, 9 studies; groundwater availability, 12 studies; seawater intrusion, 3 studies; contamination from wastewater disposal, 6 studies; contamination from landfills and hazardous waste sites, 3 studies; and contamination from agricultural practices, 2 studies. (Lantz-PTT)
W89-09207

U.S. GEOLOGICAL SURVEY GROUNDWATER STUDIES IN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
E. L. Bolke.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-129, 1988. 2p, 1 fig, 2 ref.

Descriptors: *Groundwater data, *Water resources development, *Oregon, *Groundwater budget, Groundwater movement, Hydrology, Geochemistry, Aquifers, Iron, Groundwater pollution, Groundwater quality, Intergovernmental relations.

The use of groundwater in Oregon is expected to increase owing to continued population growth and to surface water supplies that are inadequate to meet present or future demand. The major groundwater issues in Oregon are: conjunctive use of surface and groundwater; contamination from hazardous wastes, leakage from underground gasoline and diesel tanks, naturally occurring brackish water, and high concentrations of dissolved iron; groundwater availability; and Indian water rights. Before 1987, the Oregon Water Resources Department, in cooperation with the U.S. Geological Survey (USGS), maintained a network of about 400 observation wells in Oregon to monitor fluctuations in groundwater levels. Water levels currently are measured cooperatively only in active project areas. The USGS has conducted more than 120 hydrologic investigations in Oregon. During fiscal year 1987, the USGS entered into cooperative agreements with 23 local, State, and Federal agencies to conduct hydrologic investigations in Oregon; six investigations included quantitative studies of groundwater. Examples of these groundwater studies are: groundwater hydrology of the Portland basin; groundwater hydrology in the Umatilla Plateau; and iron geochemistry of a sand dune aquifer near Coos Bay. (Lantz-PTT)
W89-09210

U.S. GEOLOGICAL SURVEY GROUNDWATER STUDIES IN NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
M. D. Dettinger, and A. S. VanDenburgh.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-119, 1988. 2p, 1 fig, 3 ref.

Descriptors: *Groundwater data, *Nevada, *Groundwater recharge, Groundwater budget, Aquifers, Groundwater quality, Groundwater pollution, Intergovernmental relations.

Groundwater is an important natural resource in Nevada. In 1985, groundwater provided 24% of the total water withdrawn, and supplied about 40% of the State's population. Public supply and self-supplied domestic use accounted for about 12% of the groundwater withdrawn, and self-supplied industrial and mining use was about 3%. The major issues related to groundwater in Nevada are: groundwater availability; natural and artificial groundwater recharge; underground storage of hazardous wastes; organic and inorganic trace constituents in groundwater; and geothermal groundwater systems. The U.S. Geological Survey (USGS) is actively conducting 30 hydrologic investigations in Nevada, of which 18 are related to groundwater quantity and quality. Three examples of ongoing groundwater studies by the USGS that are designed to address specific groundwater issues in Nevada are discussed: carbonate-rock aquifers in eastern and southern Nevada; groundwater quality in the Carson River basin, Nevada-California; and groundwater in Honey Lake Valley, Nevada-California. (Lantz-PTT)
W89-09211

REGIONAL STUDY OF THE CASTLE HAYNE AQUIFER OF EASTERN NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
W. L. Lyke, and R. W. Coble.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 87-571, (1987). 2p, 2 fig, 4 ref.

Descriptors: *North Carolina, *Aquifers, *Castle Hayne Aquifer, *Hydrologic properties, Groundwater budget, Saline water intrusion, Geohydrology, Groundwater level, Groundwater management, Transmissivity.

The Castle Hayne aquifer is an eastward sloping and thickening wedge of limestone and sandstone, located in a 12,500 sq mi area in the eastern part of North Carolina. The Castle Hayne aquifer is the major source of freshwater for much of coastal North Carolina where the aquifers underlying the Castle Hayne contain saltwater. A regional study of the Castle Hayne aquifer was conducted to provide definitive information on the declines in water levels and of saltwater intrusion in the area. A series of geohydrologic maps produced from the study, show the altitude of the top of the aquifer, location of saltwater in the aquifer, aquifer thickness, aquifer transmissivity, and confining-unit thickness. The history of groundwater pumpage can be compared with historical water levels in the aquifer. These geohydrologic, pumpage, and water level data can be used to develop estimates of aquifer and confining-unit hydraulic coefficients and to develop a groundwater flow model for the Castle Hayne aquifer. The model will increase the understanding of the groundwater flow system and also can be used to assess various groundwater development scenarios for the entire Castle Hayne aquifer. (Lantz-PTT)
W89-09214

GEOHYDROLOGY AND NUMERICAL SIMULATION OF THE ALLUVIUM AND TERRACE AQUIFER ALONG THE BEAVER-NORTH CANADIAN RIVER FROM THE PANHANDLE TO CANTON LAKE, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. E. Davis, and S. C. Christenson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 81-483, October 1981. 42p, 8 fig, 2 tab, 15 plates, 35 ref.

Descriptors: *Geohydrology, *Mathematical models, *Oklahoma, *Groundwater mining, *Model studies, *Simulation analysis, Alluvial aquifers, Beaver-North Canadian River, Canton Lake, Pumpage, Groundwater budget, Aquifers.

A quantitative description of the hydrologic system in alluvium and terrace deposits along the Beaver-North Canadian River in northwestern Oklahoma is needed as an aid for planning and management of the aquifer. A two-dimensional finite-difference model was used to describe the aquifer and to predict the effects of future groundwater withdrawals. Hydraulic conductivity of the aquifer ranges from 0 to 160 ft/d and averages 59 ft/d. Specific yield is estimated to be 0.29. Recharge to the aquifer is approximately 1 in. annually. The model was used to predict future head response in the aquifer to various pumping stresses. For any one area, the pumping stress was applied until the saturated thickness for that area was < 5 ft, at which time the pumping ceased. The results of the modeled projections show that if the aquifer is stressed from 1978 to 1993 at the 1977 pumpage rates and well distribution, the average saturated thickness will decrease 1.0 ft and the volume of water in storage will be 3.94 mil acre-ft, or 97% of the 1978 volume. If the aquifer is stressed at this same rate until 2020, the average saturated thickness will decrease an additional 0.7 ft and the volume of water in storage will be 3.84 mil acre-ft, or 94% of the 1978 volume. If all areas of the aquifer having a 1978 saturated thickness of 5 ft or more are stressed from 1978 to 1993 at a rate of approximately 1.4 acre-ft/acre/yr, the average saturated thickness will decrease by 20.9 ft and the

volume of water in storage will be 1.28 mil acre-ft, or 31% of the 1978 volume. If the aquifer is stressed at this same rate until 2020, the average saturated thickness will decrease an additional 2.2 ft and the volume of water in storage will be 980,000 acre-ft, or 24% of the 1978 volume. (Lantz-PTT)
W89-09215

APPLICATION OF GAUSS ALGORITHM AND MONTE CARLO SIMULATION TO THE IDENTIFICATION OF AQUIFER PARAMETERS,
Geological Survey, Sacramento, CA. Water Resources Div.
T. J. Durbin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 81-688, 1983. 26p, 6 fig, 4 tab, 31 ref.

Descriptors: *Model studies, *Groundwater movement, *Monte Carlo method, *Aquifers, *Simulation analysis, *Recharge, *Groundwater recharge, *Data interpretation, Mathematical studies, Least squares method, Groundwater level, Hydraulic gradient, Pumpage.

The Gauss optimization technique can be used to identify the parameters of a model of a groundwater system for which the parameter identification problem is formulated as a least squares comparison between the response of the prototype and the response of the model. Unavoidable uncertainty in the true stress on the prototype and in the true response of the prototype to that stress will introduce errors into the parameter identification problem. A method for evaluating errors in the predictions of future water levels due to errors in recharge estimates was demonstrated. The method involves a Monte Carlo simulation of the parameter identification problem and of the prediction problem. The steps in the method are: (1) to prescribe the distribution of the recharge estimates; (2) to use this distribution to generate random sets of recharge estimates; (3) to use the Gauss optimization technique to identify the corresponding set of parameter estimates for each set of recharge estimates; (4) to make the corresponding set of hydraulic head predictions for each set of parameter estimates; and (5) to examine the distribution of hydraulic head predictions and to draw appropriate conclusions. Similarly, the method can be used independently or simultaneously to estimate the effect on hydraulic head predictions of errors in the measured water levels that are used in the parameter identification problem. The fit of the model to the data that are used to identify parameters is not a good indicator of these errors. A Monte Carlo simulation of the parameter identification problem can be used, however, to evaluate the effects on water level predictions of errors in the recharge (and pumpage) data used in the parameter identification problem. (Lantz-PTT)
W89-09216

THREE-DIMENSIONAL MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC SYSTEM IN THE PICEANCE BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
O. J. Taylor.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open-File Report 82-637, 1982. 35p, 11 fig, 6 tab, 9 plates, 25 ref.

Descriptors: *Model studies, *Hydrologic models, *Mathematical models, *Simulation analysis, *Hydrologic properties, *Geohydrology, *Colorado, *Piceance Creek, Yellow Creek, Roan Creek, Parachute Creek, Aquifers, Groundwater recharge, Model studies, Hydraulic conductivity, Transmissivity, Groundwater movement, Hydrologic systems.

The Piceance basin extends over an area of about 1,600 sq mi in northwestern Colorado and includes the drainage basins of Piceance, Yellow, Roan, and Parachute Creeks. Beneath the drainage basins lie the Uinta and Green River Formations of Eocene age and older rocks. The Uinta and Green River Formations consist of marlstone, sandstone, and siltstone and include large reserves of oil shale. Extensive fracturing and leaching of the formations has increased their permeability and resulted in aquifers that lie within, above, and below the oil shale deposits. The hydrologic system of the basin consists of natural recharge from precipitation, circulation through fractured aquifers and confining beds, and discharge to stream valleys or seepage faces. Previous models were utilized to simulate the flow systems in the northern part of the Piceance basin. A preliminary three-dimensional, five-layer simulation model was prepared for the entire basin using available hydrologic data. The model was used in a steady-state error analysis to assess the degree of error in the hydrologic parameters used in the model. This analysis indicated that simulated hydrologic characteristics are plausible, all layers exhibit impaired vertical hydraulic conductivity, and one layer may exhibit lateral directional transmissivity. However, the model could not be calibrated because of the paucity of data in some regions of the basin. (Author's abstract)
W89-09222

WATER RESOURCES OF ROCKLAND BASIN, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09223

APPRAISAL OF WATER IN BEDROCK AQUIFERS, NORTHERN CASCADE COUNTY, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
K. R. Wilke.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-1025, January 1983. 29p, 3 fig, 2 tab, 2 plates, 31 ref.

Descriptors: *Water resources data, *Montana, *Groundwater quality, *Aquifers, *Bedrock, Groundwater budget, Groundwater level, Groundwater, Mixing, Groundwater movement, Dissolved solids, Minerals, Water demand, Conductance.

Suburban residential expansion of the city of Great Falls has resulted in an increased demand on water supplies from bedrock aquifers in northern Cascade County. The unconsolidated deposits aquifer of Quaternary age, including alluvium and glacial lake deposits, also is an important source of water in the area. Water levels in the Madison-Swift aquifer and all overlying aquifers, including the Quaternary deposits aquifer, reflect unconfined (water-table) conditions in the Great Falls vicinity. This interconnected hydrologic system is the result of breaching of the major anticlinal structure, by ancestral and present day erosion of drainage channels by the Missouri River and its tributaries. Significant vertical inter-aquifer mixing of water, as well as surface water/groundwater interchange, probably occurs in the central part of the study area. Characterization of the chemical composition of water in individual aquifers based on samples from wells in this area probably is unreliable because of this mixing. Quality of water from two wells in the Madison-Swift aquifer near Giant Springs is similar to water from the springs. Water from these three samples is less mineralized than most groundwater in the study area; dissolved solids concentrations for the three samples range from 516 to 550 mg/L. The quality of water varies among aquifers and throughout the study area. The ranges of dissolved solids concentrations determined by chemical analysis are Madison-Swift aquifer, about 520 to 1,570 mg/L; Morrison Formation, 908 to 1,480 mg/L; Kootenai Formation, 558 to 1,550 mg/L; Colorado Group, 2,690 and 2,740 mg/L (two samples); and unconsolidated Quaternary deposits, 383 to 2,060 mg/L. The chemical quality of water from the Colorado Group in the western one-third of the area generally is more mineralized than water from aquifers in the rest of the area. Specific conductance of water from eight wells completed in the Colorado Group averages 4,440 micromhos at 25 C. (Author's abstract)
W89-09225

BASE OF MODERATELY SALINE GROUND WATER IN THE UINTA BASIN, UTAH, WITH AN INTRODUCTORY SECTION DESCRIBING THE METHODS USED IN DETERMINING ITS POSITION,
Geological Survey, Salt Lake City, UT. Water Resources Div.
L. Howells, M. S. Longson, and G. L. Hunt.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-397, 1987. Utah Department of Natural Resources Technical Publication No. 92, 1987. 59p, 10 fig, 1 tab, 2 pl in pocket, 60 ref.

Descriptors: *Groundwater basins, *Well logs, *Groundwater quality, *Salinity, *Geohydrology, *Utah, Data acquisition, Sodium chloride, Sodium bicarbonate, Groundwater movement, Resistivity, Brine, Saline water intrusion, Subsurface mapping, Brines.

The base of the moderately saline water (water that contains from 3,000 to 10,000 mg/L of dissolved solids) was mapped by using available water quality data and by determining formation-water resistivities from geophysical well logs based on the resistivity-porosity, spontaneous-potential, and resistivity-ratio methods. The contour map developed from these data showed a mound of very saline and briny water, mostly of sodium chloride and sodium bicarbonate type, in most of that part of the Uinta Basin that is underlain by either the Green River or Wasatch Formations. Along its northern edge, the mound rises steeply from below sea level to within 2,000 ft of the land surface and, locally, to land surface. Along its southern edge, the mound rises less steeply and is more complex in outline. This body of very saline to briny water may be a lens; many wells or test holes drilled within the area underlain by the mound re-entered fresh to moderately saline water at depths of 8,000 to 15,000 ft below land surface. (Author's abstract)
W89-09229

TEST WELLS TW1, TW2, AND TW3, WHITE SANDS MISSILE RANGE, OTERO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. G. Myers, and K. M. Pinckley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-47, 1987. 19p, 5 fig, 4 tab, 2 ref.

Descriptors: *Toxic wastes, *Test wells, *Waste disposal, *White Sands, *New Mexico, *Monitoring, Water quality control, Borehole geophysics, Military reservations, Groundwater quality, Hazardous wastes, Boreholes, Lithologic logs.

Three test wells, TW1, TW2, and TW3, were drilled at White Sands Missile Range in south-central New Mexico in July, August, and October 1983 as part of a joint military training program sponsored by the U.S. Navy and U.S. Army in July, August, and October 1983. The test wells were drilled as exploratory and monitoring wells for the toxic waste storage facility at White Sands Missile Range. Information obtained from these wells includes lithologic logs for all wells and borehole-geophysical logs for the cased wells. (Author's abstract)
W89-09231

MICROCOMPUTER-BASED VERSION OF SIPT--A PROGRAM FOR THE INTERPRETATION OF SEISMIC-REFRACTION DATA (TEXT),
Geological Survey, Hartford, CT. Water Resources Div.
F. P. Haeni, D. G. Grantham, and K. Ellefsen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-103-A, 1987. 38p, 12 fig, 2 tab, 38 ref, append.

Descriptors: *Seismic properties, *Geophysics, *Seismic data, *Computer programs, *Geohydrology, *Data interpretation, *Seismographs, *Refractivity, Computers, Computer models, Model studies, Mathematical studies, Geology, Microcomputers, Documentation, Subsurface mapping, SIPT.

Use of a microcomputer based FORTRAN program, SIPT1.FOR, for the interpretation of seismic-refraction data is documented, and an interpretation procedure using SIPT1.FOR is outlined. SIPT1.FOR is an adaptation of SIPT22.FOR and SIPT23.FOR, programs developed for use on mainframe computer systems. The program has been adapted for interactive use on microcomputers that use a DOS 3.0 operating system. SIPT1.FOR can be used to interpret seismic-refraction data for complex field situations and geologic settings. The program is a two-dimensional modeling process in which the delay-time technique is used to obtain a first approximation of model layers and then an iterative ray tracing technique is used to refine the model. Error detection, feedback, and automatic adjustment are written into the program. The program can handle multilayer dipping bed problems for multiple geophone spreads and complex field situations such as offset shotpoints, nonlinear geophone spacing, and variable land-surface topography. Instructions for the use of SIPT1.FOR, a discussion of the interpretation process, and an example problem are included in the documentation. (Author's abstract)
W89-09233

WATER-QUALITY ASSESSMENT OF THE CARSON RIVER GROUND-WATER BASIN, NEVADA AND CALIFORNIA: PROJECT DESCRIPTION,
Geological Survey, Carson City, NV. Water Resources Div.
A. H. Welch, and R. W. Plume.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-104, 1987. 27p, 4 fig, 32 ref.

Descriptors: *Groundwater basins, *Nevada, *California, *Carson Groundwater Basin, *Nevada, California, *Water quality control, *Groundwater quality, *Project planning, Geohydrology, Groundwater management, Aquifers, Carson River, Land use, Arid lands, Data interpretation, Data acquisition.

In April 1986, the U.S. Geological Survey began a pilot program to assess the quality of the nation's surface water and groundwater resources. This program, called the National Water-Quality Assessment (NAWQA) program, is designed to acquire and interpret information about a wide range of water quality issues. The program is in its early stages and consists of four surface water and three groundwater pilot projects. The objectives of the Carson River basin NAWQA project are described in the context of the national program, the study area and its associated water quality issues, and a proposed study approach. The objectives of the Carson River basin NAWQA project are to: (1) investigate regional groundwater quality; (2) describe relations of groundwater quality to land use, geohydrology, and other pertinent factors; (3) provide a general description of the location, nature and possible causes of selected widespread water quality problems in the project area; and (4) develop new techniques for characterizing regional groundwater quality, especially in arid alluvial basins. There are to be three major phases of the Carson River basin project. The first will consist of compilation and analysis of existing data. The second phase will consist of a regional water quality survey that will produce a consistent set of data that can be used to: (1) define regional quality of groundwater within the Carson River basin; and (2) compare that water quality with other aquifers in the Nation. The third phase will include topical studies that will define groundwater quality in the Carson River basin with respect to certain constituents, either basin wide or within specific areas of concern. (Lantz-PTT)
W89-09234

GROUND-WATER-QUALITY ASSESSMENT OF THE DELMARVA PENINSULA, DELAWARE, MARYLAND, AND VIRGINIA: PROJECT DESCRIPTION,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09238

WATER-LEVEL DATA FROM WELLS IN THE VICINITY OF THE WASTE ISOLATION PILOT PLANT, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
S. F. Richey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-120, 1987. 107p, 2 fig, 61 tab.

Descriptors: *Hydrologic data collections, *Radioactive waste disposal, *Groundwater level, *Wells, *New Mexico, Measuring instruments, Data acquisition, Monitoring, Disposal sites.

The U.S. Geological Survey monitored water levels in wells in the vicinity of the Waste Isolation Pilot Plant, a storage facility constructed in bedded salts in which defense-associated transuranic wastes will be deposited, in southeastern New Mexico during 1977 to 1985. A variety of methods was used to measure water levels. The particular method utilized at a given time depended on several factors, including the amount of condensation in the well, well-head configuration, depth to water, rate of water level change, and availability of equipment. The five methods utilized were: air line, Lynes pressure sentry system, M-scope, steel tape, and winch. (Lantz-PTT)
W89-09241

DISTRIBUTION OF RADIONUCLIDE AND TRACE-ELEMENTS IN GROUND WATER, GRASSES, AND SURFICIAL SEDIMENTS ASSOCIATED WITH THE ALLUVIAL AQUIFER ALONG THE PUERCO RIVER, NORTHEASTERN ARIZONA--A RECONNAISSANCE SAMPLING PROGRAM,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09243

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1985 AND 1986,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09247

NATIONAL AND REGIONAL TRENDS IN WATER-WELL DRILLING IN THE UNITED STATES, 1964-84,
Geological Survey, Columbus, OH. Water Resources Div.
S. M. Hindall, and M. Eberle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-247, 1987. 25p, 6 fig, 4 tab, 16 ref.

Descriptors: *Drilling, *Wells, Project planning, Groundwater management, Texas, Florida, New York, Michigan, North Carolina, Virginia, Ohio, Qualitative analysis.

Information on national and regional water well drilling activity is important for water resource planning and management and for water related equipment marketing. A study was conducted to analyze drilling trends on the basis of data for selected years from 1964 through 1984. The study focused primarily on the years 1964 and 1980-84, but also included data from 1960. Approximately 397,000 water wells were drilled in the United States in 1984. Seven states--Florida, Texas, New York, Michigan, North Carolina, Virginia, and Ohio--accounted for 39% of all the wells drilled in the United States in 1984. Florida led the nation in drilling activity with 45,600 new wells. The 1984 national drilling total was 2.6% > the total for 1980 (387,000) and 8.5% < the total for 1964 (434,000). However, these moderate differences do not reflect substantial year-to-year fluctuations that may have occurred during that 20-yr period. Qualitative comparisons suggest that drilling activity for a given year is closely related to the number of housing starts for that year. If so, there may have been peaks in drilling activity in 1972 and 1977-78 (corresponding to peaks in housing starts) that are not identified in this study because of a lack of available well drilling data for those years. Well drilling data for 1964 and the 1980-84 period probably represent a low to moderate level of drilling activity, and, if compared to earlier data, suggest that there has been no substantial growth or decline in the water well industry as a whole since the 1940's. (Author's abstract)
W89-09250

WATER RESOURCES ACTIVITIES, GEORGIA DISTRICT, 1986,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09252

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA--FISCAL YEARS 1986-87,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09253

HYDROLOGIC DATA FOR THE SAN JUAN AND ANIMAS RIVER VALLEYS IN THE FARMINGTON, AZTEC, BLOOMFIELD, AND CEDAR HILL AREAS, SAN JUAN COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. P. McAda, and S. G. Shelton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-385, 1987. 18p, 6 fig, 4 tab.

Descriptors: *Data collections, *Water quality, *Path of pollutants, *Groundwater movement, *Groundwater quality, *Hydrologic data, *San Juan River, *Animas River, *New Mexico, Chemical analysis, Hydrologic data collections, Wells, Groundwater level, Observation wells, Organic compounds.

In July 1985, the U.S. Geological Survey initiated a three-year study in San Juan County, New Mexico, to determine the concentrations of chemical constituents in the groundwater in the San Juan and Animas River valleys and to determine the direction and rate of groundwater flow and its relation to river stage. The study was conducted in cooperation with the San Juan County Commission and the New Mexico Oil Conservation Division. The data that was collected during the first 1-1/2 yr of the study is completed. The report includes well records for 51 wells and water levels from 23 wells, hydrographs from four observation wells and one river stage site, and available chemical analyses from 50 wells and 14 surface water sites. Water samples from six wells and one surface-water site were analyzed for purgeable organic chemicals; none were detected. (Lantz-PTT)
W89-09254

MOVEMENT AND FATE OF CHLORINATED SOLVENTS IN GROUND WATER: RESEARCH ACTIVITIES AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09258

INDEX TO SELECTED MACHINE-READABLE GEOHYDROLOGIC DATA FOR PRECAMBRIAN THROUGH CRETACEOUS ROCKS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-09259

SELECTED WATER-LEVEL DATA FOR MESOZOIC FORMATIONS IN THE UPPER COLORADO RIVER BASIN, ARIZONA, COLORADO, UTAH, AND WYOMING--EXCLUDING THE SAN JUAN BASIN,
Geological Survey, Salt Lake City, UT. Water Resources Div.
J. F. Weigel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-397, 1987. 73p, 4 fig, 2 tab, 4 ref.

Descriptors: *Hydrologic data collections, *Colorado River, *Groundwater level, *Arizona, *Colorado, *Utah, *Wyoming, Water level, Wells, Groundwater budget, Data collections.

Water level data from selected water wells completed in and from selected petroleum exploration wells penetrating Mesozoic formations in the Upper Colorado River Basin have been collected by various government agencies, private industry, and others. These data, which were compiled, analyzed, and summarized by the USGS are presented. One-time water levels are presented for 1,125 water wells. Water levels computed from 3,298 drill-stem tests at 1,871 sites expanded the data base in areas where mesozoic formations are too deep to be penetrated by water wells at the present time (1987). (Author's abstract)
W89-09260

2G. Water In Soils

THREE-PHASE FLOW ANALYSIS OF OIL SPILLS IN PARTIALLY WATER-SATURATED SOILS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08246

MEANS FOR PROVIDING A VERTICAL DRAIN IN SOIL,
For primary bibliographic entry see Field 4A.
W89-08279

DRAINING, IRRIGATING AND DISPERSING MASS,
For primary bibliographic entry see Field 4A.
W89-08296

DRAINAGE TUBE,
A.A.R.C. (Management) Pty. Limited, Victoria (Australia). (Assignee).
For primary bibliographic entry see Field 4A.
W89-08301

PREDICTING POTENTIAL ALUMINUM CONTAMINATION OF SURFACE AND GROUNDWATERS FROM ACID SULFATE ENRICHED DRAINAGES EMANATING FROM LOW NEUTRALIZATION CAPACITY WATERSHEDS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5B.
W89-08337

GROUNDWATER CONTAMINATION FOR AGRICULTURALLY APPLIED PESTICIDES,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 5A.
W89-08342

DISTRIBUTION OF GASES IN THE UNSATURATED ZONE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
R. G. Striegl.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4025, 1988. 76p, 38 fig, 10 tab, 26 ref.

Descriptors: *Aeration zone, *Soil gases, *Radioactive wastes, *Carbon dioxide, *Methane, *Carbon radioisotopes, *Tritium, *Nitrogen, *Oxygen, Radon, Unsaturated zone, Illinois.

The unsaturated zone is a medium that provides pneumatic communication for the movement of gases from wastes buried in landfills to the atmosphere, biota, and groundwater. Gases in unsaturated glacial and eolian deposits near a waste-disposal trench at the low-level radioactive-waste disposal site near Sheffield, Bureau County, Illinois, were identified, and the spatial and temporal distributions of the partial pressures of those gases were determined for the period January 1984 through January 1986. Methods for the collection and analyses of the gases are described, as are geologic and hydrologic characteristics of the unsaturated zone that affect gas transport. The identified gases, which are of natural and of waste origin, include nitrogen, oxygen, and argon, carbon dioxide, methane, propane, butane, tritiated water vapor, 14carbon dioxide, and 222 radon. Concentrations of methane and 14carbon dioxide originated at the waste, as shown by partial-pressure gradients of the gases; 14carbon dioxide partial pressures exceeded natural background partial pressures by factors greater than 1 million at some locations. Variations in partial pressures of oxygen and carbon dioxide were seasonal among piezometers because of increased root and soil-microbe respiration during summer. Variations in methane and 14carbon dioxide partial pressures were apparently related to discrete releases from waste sources at unpredictable intervals of time. No greater than background partial pressures for tritiated water vapor or 222 radon were measured. (USGS)
W89-08418

IN-SITU CONTROL OF GROUNDWATER CONTAMINATION BY MICROBIOLOGICAL PROCESSES,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 5B.
W89-08432

VARIABLY SATURATED FLOW BETWEEN STREAMS AND AQUIFERS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W89-08434

ACID SOIL AND ACID RAIN: THE IMPACT ON THE ENVIRONMENT OF NITROGEN AND SULPHUR CYCLING,
Sydney Univ. (Australia).
For primary bibliographic entry see Field 5C.
W89-08467

ELECTRICAL LEAK LOCATION METHOD FOR GEOMEMBRANE LINERS,
Southwest Research Inst., San Antonio, TX.
For primary bibliographic entry see Field 5E.
W89-08527

SUPERFUND RECORD OF DECISION: GOLD COAST, FL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08541

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1987,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09000

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09088

ESTIMATING SOIL MATRIC POTENTIAL IN OWENS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
S. K. Sorenson, R. F. Miller, M. R. Welch, D. P. Groeneveld, and F. A. Branson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-79, 1988. 31p, 11 fig, 2 tab, 45 ref.

Descriptors: *Soil water potential, *Soil water, *Plant water potential, *Owens Valley, *California, Model studies, Mathematical studies.

Much of the floor of the Owens Valley, California, is covered with alkaline scrub and alkaline meadow plant communities, whose existence is dependent partly on precipitation and partly on water infiltrated into the rooting zone from the shallow water table. The extent to which these plant communities are capable of adapting to and surviving fluctuations in the water table depends on physiological adaptations of the plants and on the water content, matric potential characteristics of the soils. Two methods were used to estimate soil matric potential in test sites in Owens Valley. The first was the filter-paper method, which uses water content of filter papers equilibrated to water content of soil samples taken with a hand auger. The other method of estimating soil matric potential was a modeling approach based on data from this and previous investigations. These data indicate that the base 10 logarithm of soil matric potential is a linear function of gravimetric soil water content for a particular soil. Estimates of soil water characteristic curves were made at two sites by averaging the gravimetric soil water content and soil matric potential values from multiple samples at 0.1 m depths derived by using the hand auger and filter paper method and entering these values in the soil water model. The characteristic curves then were used to estimate soil matric potential from estimates of volumetric soil water content derived from neutron-probe readings. Evaluation of the modeling technique at two study sites indicated that estimates of soil matric potential within 0.5 pF units of the soil matric potential value derived by using the filter paper method could be obtained 90 to 95% of the time in soils where water content was less than field capacity. The greatest errors occurred at depths where there was a distinct transition between soils of different textures. (Lantz-PTT)
W89-09198

FLOW IN THE UNSATURATED ZONE TUCSON, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09209

WATER MOVEMENT IN THE UNSATURATED ZONE AT A LOW-LEVEL RADIOACTIVE-WASTE BURIAL SITE NEAR BARNWELL, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
K. F. Dennehy, and P. B. McMahon.
Available from Books and Open File Report Sec-

tion, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-46, 1987. 66p, 32 fig, 3 tab, 26 ref.

Descriptors: *Infiltration, *Soil water, *Groundwater movement, *Radioactive waste disposal, *Aeration zone, *South Carolina, *Underground waste disposal, *Path of pollutants, Geohydrology, Monitoring, Groundwater recharge, Groundwater level, Precipitation, Hydrologic models, Climatology, Groundwater barriers.

Four unsaturated zone monitoring sites and a meteorologic station were installed at the low level radioactive waste burial site near Barnwell, South Carolina, to investigate the geohydrologic and climatologic factors affecting water movement in the unsaturated zone. The study site is located in the Atlantic Coastal Plain. The unsaturated zone consists of a few centimeters to > 1 m of surface sand, underlain by up to 15 m of clayey sand. Two monitoring sites were installed in experimental trenches and two were installed in radioactive waste trenches. Two different trench designs were evaluated at the monitoring sites. A meteorologic station was used to measure precipitation and to calculate actual evapotranspiration using the Bowen ratio method. Soil-moisture tensiometers, soil-moisture conductance probes, and temperature sensors were used to monitor soil-water movement in and adjacent to the trenches. Tracer tests using sodium chloride were conducted at each monitoring site. Data collection at the monitoring sites began in January 1982 and continued until early May 1984. Tensiometer data show that the unsaturated materials had their highest percent saturations in the winter and spring. Saturations in the backfill sand varied from 20 to 100%. They varied from about 75 to 100% in the adjacent undisturbed and overlying compacted clayey sand. Additionally, because tensiometer data indicate negligible water storage changes in the unsaturated zone, it is estimated that approximately 43 cm of recharge reached the water table. During 1984, the rise and fall of ponded water in an experimental trench was continuously monitored with a digital recorder. A cross-sectional finite element model of variably saturated flow was used to test the conceptual model of water movement in the unsaturated zone and to illustrate the effect of trench design on water movement into the experimental trenches. Monitoring and model results show that precipitation on trenches infiltrated the trench cap and moved vertically into the trench backfill material. The trench construction practice of placing a compacted clayey-sand barrier around the trench greatly inhibits soil water from entering the trench. (Author's abstract)
W89-09230

2H. Lakes

NITROGEN CYCLE AND COMMUNITY INTERACTIONS IN A COLD WATER SPRING DOMINATED BY A NITROGEN FIXING CYANOBACTERIUM,
Oregon Univ., Eugene. Dept. of Biology.
W. K. Dodds.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8629553. Ph.D. Dissertation, 1986. 125p, 12 fig, 20 tab, 120 ref, append.

Descriptors: *Nitrogen fixing bacteria, *Limnology, *Springs, *Cold springs, *Bacterial analysis, *Nostoc, Nitrogen cycle, Denitrification, Nitrogen removal, Microbiological studies.

The large colonies of the nitrogen fixing cyanobacterium, Nostoc pruniforme Ag, that dominate a spring fed pool (Mare's Egg Spring, Oregon) were investigated. The relationship between Nostoc and other organisms to nitrogen cycling in the pool, their sensitivity to the addition of nitrate and to decreases in the flow rate, and other factors affecting Nostoc growth were studied. Values for denitrification rates in sediments varied by a factor of 10 and variance of many other fluxes was also high, suggesting high variance may be an intrinsic biological property of oligotrophic systems. The sediments demonstrated both nitrifying and denitrifying activity in the presence of oxygen. Nitrification rates probably do not limit rates of denitrification in these oligotrophic sediments. Use of plastic enclosures or limnocorrals showed that short-term increases of nitrate in nitrogen poor aquatic systems do not necessarily affect the biological community but increases in the water replacement time of small ponds may have significant effects. N. pruniforme growth was significantly correlated with incoming solar radiation. The grazing of the snail Vorticifex effusa on the surface of the N. pruniforme colonies had a positive effect on their growth. (Cremmins-AEPCO)
W89-08249

SEDIMENT INFLOW, OUTFLOW, AND DEPOSITION FOR LAKES MARION AND MOULTRIE, SOUTH CAROLINA OCTOBER 1983 - MARCH 1985,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-08358

WATER QUALITY ASSESSMENT OF ARVADA RESERVOIR, DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
L. J. Britton, and N. G. Gaggiani.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4107, 1988. 200p, 7 fig, 28 tab, 7 ref.

Descriptors: *Reservoirs, *Water quality, *Limnology, *Trophic level, *Arvada Reservoir, *Colorado, Limiting nutrients.

Water quality data were collected from Arvada Reservoir, Colorado which completed filling in May 1984, and from its major inflows, Ralston Creek and Croke Canal, to assess the physical, chemical, and biological quality of the reservoir; to evaluate the effect of water from various sources on the reservoir; and to estimate the trophic state of the reservoir. Data were collected at five sites in Arvada Reservoir, one site in Ralston Creek, and two sites in Croke Canal. The study began in June 1983 and continued through September 1985. The reservoir was thermally stratified on most sampling dates, generally from April through September during the study period. Dissolved-oxygen concentrations ranged from 0 to 12.0 mg/L, and the reservoir was anaerobic below the 10 m depth during most of the summer. Secchi-disk-depth measurements ranged from 0.9 to 5.5 m and generally increased during the study period, possibly because of decreases in nonalgal turbidity after the reservoir was filled. The results of chemical analyses indicate that water from the reservoir generally is of suitable quality for a raw-water-supply source and for maintenance of aquatic life. Total-nitrogen and total-phosphorus concentrations were small, and both were growth-limiting factors in the reservoir. The phytoplankton community was diverse, and the most dominant taxa were diatoms. Phytoplankton densities ranged from 1,400 to 29,000 cells/milliliter, and chlorophyll a concentrations ranged from 0.0 to 20.4 micrograms/L. (USGS)
W89-08411

ASSESSING THE SENSITIVITY OF HIGH ALTITUDE NEW MEXICAN WILDERNESS LAKES TO ACIDIC PRECIPITATION AND TRACE METAL CONTAMINATION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-08433

HYDROLOGY OF THE FLORAL CITY POOL OF TSALA APOPKA LAKE, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. A. Bradner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4024, 1988. 97p, 17 fig, 1 tab, 18 ref. USGS project FL-431.

Descriptors: *Hydrology, *Lakes, *Florida, *Drought, Water level, Surface water, Groundwater, Water quality.

Tsala Apopka Lake, in west-central Florida, has an area of about 19,000 acres and is divided into three water-management pools, with the Floral City Pool, the most upgradient. The Floral City Pool, which has a surface area of approximately 4,750 acres, contains an extensive combination of lakes, wetlands, and connecting canals. The Pool receives inflow from the Withlacoochee River through two canals. Outflow is through one manmade canal and one natural slough. Canal flow is partially controlled by manmade structures. A cumulative deficit of 19.4 inches of rainfall from August 1984 through May 1985 reduced surface-water inflow to the Floral City Pool to about 0.5 cu ft/sec by May 1985. During May 1985, pool levels declined approximately 0.04 ft/day. By the end of May, there was no observable outflow. From June 1985 through September 1985, 39.8 inches of rainfall caused above-average inflow to the Floral City Pool and a pool-level increase of 6.2 ft. The inflow of 340 CFS nearly equaled the outflow of 338 CFS by the end of September. (USGS)
W89-08455

WESTERN LAKE SURVEY, PHASE I. CHARACTERISTICS OF LAKES IN THE WESTERN UNITED STATES: VOLUME II. DATA COMPENDIUM FOR SELECTED PHYSICAL AND CHEMICAL VARIABLES,
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
For primary bibliographic entry see Field 5B.
W89-08500

BUFFALO METROPOLITAN AREA, NY, ERIE COUNTY ALONG LAKE ERIE AND NIAGARA RIVER--SHORELINE PROTECTION INTERIM RECONNAISSANCE REPORT.
Army Engineer District, Buffalo, NY.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A194 060. Price codes: A04 in paper copy, A01 in microfiche. Army Corp of Engineers, Buffalo District, December 1987. 72p, 23 tab, 12 plates.

Descriptors: *Flood control, *Management planning, *Lake Erie, *Shore protection, New York, Woodlawn, Dikes, Levees, Economic aspects, Flood damage, Flood protection, Buffalo, Niagara River, Wave runup, Economic Efficiency.

Based on input from local officials, Woodlawn, New York, was the sole site in Erie County, New York, with flood damages meriting Federal investigation. The data presented in this report clearly demonstrates that Woodlawn, New York, receives minimal damages on an annual basis from Lake Erie waters. These damages are usually only experienced as the result of rare lake events, when lake water may enter Woodlawn from overtopping the south Blasdell Creek dike or from wave runup over high ground to the southwest. The one plan developed besides the no-action plan, namely levees, did not meet the economic efficiency criterion (having a benefit-to-cost ratio considerably less than 1.0). No economically feasible plan was found that reduced lake level induced damages. (Lantz-PTT)
W89-08553

UPLAND HABITAT DEVELOPMENT ON DREDGED MATERIAL PLACEMENT SITES, UPPER MISSISSIPPI RIVER, POOL 18,
Army Engineer District, Rock Island, IL.
For primary bibliographic entry see Field 6G.
W89-08560

BENEFICIAL USES OF DREDGED MATERIAL IN SEVEN NEW ENGLAND PROJECTS,
Baystate Environmental Consultants, Inc., East Longmeadow, MA.
For primary bibliographic entry see Field 5G.
W89-08565

BENEFICIAL USES FROM DREDGED LAKE SEDIMENTS IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W89-08566

OVERVIEW OF PAST AND POTENTIAL NATURAL RESOURCE BENEFICIAL USES OF DREDGED MATERIAL IN THE GREAT LAKES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5E.
W89-08569

DELINEATION AND CLASSIFICATION OF INLAND WETLANDS UTILIZING FCIR STEREO IMAGERY,
For primary bibliographic entry see Field 7B.
W89-08589

PRESENT STATE, CHANGES AND QUALITY OF SOLOGNE AND BRENNE, TWO FRENCH LARGE WETLANDS, STUDIED WITH THE MSS AND TM LANDSAT DATA,
Ministere de l'Environnement et du Cadre de Vie, Neuilly-sur-Seine (France).
For primary bibliographic entry see Field 7C.
W89-08593

WATER QUALITY MONITORING OF LAKE BALATON USING LANDSAT MSS DATA,
Tokai Univ., Hiratsuka (Japan). Research and Information Center.
For primary bibliographic entry see Field 7C.
W89-08599

ALGAE AND HUMAN AFFAIRS.
Cambridge University Press, New York. 1988. 590p. Edited by Carole A. Lembi and J. Robert Waaland.

Descriptors: *Algae, *Aquatic plants, *Aquatic productivity, Algae blooms, Algal toxins, Algal control, Algal growth, Aquaculture, Economic aspects, Ecological effects, Taste-producing algae, Odor-producing algae.

It has become apparent that the productivity associated with algae in natural communities can be harnessed commercially into productivity tailored to human specifications. The invcstigation of algae for specialty uses and products such as hydrocolloids, carotene, gourmet foods, and diatomaceous earth is currently of great interest. However, the impact of algae on human society is not limited to the harvesting or growing of species that are economically useful. Algae play essential roles with significant and lasting impacts on the biosphere. Their photosynthetic activity contributes oxygen to the atmosphere and their fossil remains have produced petroleum and the white chalk cliffs at Dover. Algae are the major source of food for many aquatic organisms and provide an essential link in the aquatic food chain. They can become nuisance organisms by polluting water supplies with foul tastes, odors, and even toxins, causing millions of dollars in economic disruptions. A series of papers covering the role of algae in the natural environment, industry and agriculture, causing adverse impacts, and future human affairs is presented. (See W89-08613 thru W89-08617) (White-Reimer-PTT)
W89-08612

WATER QUALITY OF LAKE TUSCALOOSA AND STREAMFLOW AND WATER QUALITY OF SELECTED TRIBUTARIES TO LAKE TUSCALOOSA, ALABAMA, 1982-86,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
L. J. Slack.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4002, 1987. 64p, 27 fig, 7 tab, 27 ref.

Descriptors: *Lake Tuscaloosa, *Water quality, *Streamflow, *Reservoirs, *Alabama, Tributaries, Sulfates, Dissolved solids, Iron, Drinking water, Manganese, Dissolved oxygen, Water temperature.

Lake Tuscaloosa, created in 1969 by the impoundment of North River, provides the primary water supply for Tuscaloosa, Alabama, and surrounding areas. This report describes the percent contribution of major tributaries to the mean inflow to the lake; water quality; and changes in water quality in the lake and selected tributaries. During base flow, about 60% of the total flow into Lake Tuscaloosa is contributed by Binion and Carroll Creeks, which drain only 22% of the Lake Tuscaloosa basin. Binion and Carroll Creek basins are underlain primarily by sand and gravel deposits of the Coker Formation. Mean inflow to the lake was 1,150 cu ft/sec during 1983, a wet year, and 450 cu ft/sec during 1985, a relatively dry year. More than 80% of the total inflow during both years was contributed by North River and Binion, Cripple, and Carroll Creeks. About 59% was contributed by North River during those years. Except for pH, sulfate, and dissolved and total recoverable iron and manganese, the water quality of the tributaries is generally within drinking water limits and acceptable for most uses. The water quality of Lake Tuscaloosa is generally within drinking water limits and acceptable for most uses. The maximum and median concentrations of sulfate increased every year at the dam from 1979 to 1985 (7.2 to 18 mg/L and 6.2 to 14 mg/L, respectively). The dissolved solids concentrations for water at the dam have varied (1979-86) from 27 to 43 mg/L; the sulfate, 5.2 to 18 mg/L; and the dissolved iron, 10 to 250 micrograms/L--all within the recommended drinking water limits. However, concentrations of dissolved manganese and total recoverable iron and manganese at the dam commonly exceeded the recommended drinking water limits. In November 1985, after the summer warmup and increase in biological activity, the water quality at five depth profiles sites on Lake Tuscaloosa was acceptable for most uses, generally. However, a dissolved oxygen concentration of 1 mg/L or less was observed within 5 to 10 ft of the bottom for several depth profiles. At depths > 35 to 40 ft (out of a total depth of about 50 to 100 ft) the dissolved oxygen concentration was < 5 mg/L at several sites. By mid-January 1986, the temperature and dissolved oxygen depth profiles were virtually constant from top to bottom of the lake at all five sites; this indicated that lake turnover was complete. However, significant variation existed in pH depth profiles. (Author's abstract)
W89-08630

RECONNAISSANCE OF THE GROUNDWATER, SURFACE WATER SYSTEM IN THE ZEKIAH SWAMP RUN BASIN, CHARLES AND PRINCE GEORGES COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08643

WATER QUALITY OF CALERO RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA, 1981-83,
Geological Survey, Sacramento, CA. Water Resources Div.
D. G. Clifton, and I. S. Gloege.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4105, 1987. 41p, 9 fig, 7 tab, 27 ref.

Descriptors: *Calero Reservoir, *Water quality, *Santa Clara, *California, Turbidity, Dissolved oxygen, Specific conductivity, Calcium, Magnesium, Nitrogen, Phosphorus, Primary productivity, Eutrophic lakes, Water pollution effects.

Data were collected from December 1980 to September 1983 to describe water quality conditions of Calero Reservoir and the Almaden-Calero canal, Santa Clara County, California. Results show that water in Calero Reservoir and the canal generally met water quality criteria, as identified by the California Regional Water Quality Control Board San Francisco Bay Region, for municipal and domestic supply, water contact and non-contact recreation, warm water fish habitat, wildlife habitat, and fish spawning. Water temperature profiles show that Calero Reservoir can be classified as a warm monomictic reservoir. Water transparency profiles showed rapid attenuation of light with depth in the water column. The depth of the euphotic zone ranged from .5 m to 5.0 m. In winter and spring, light-extinction values generally were high throughout the water column; in summer and fall, values generally were high near the reservoir bottom. Dissolved oxygen concentrations were < 5.0 mg/L in about 22% of the measurements. Median pH values were 7.9 in the reservoir and 8.4 in the canal. Mean specific conductance values were 299 microsiemens/cm at 25 C in the reservoir and 326 in the canal. Calcium and magnesium were the dominant cations and bicarbonate the dominant anion in Calero Reservoir. Concentrations of total recoverable mercury in the bottom sediments in Calero Reservoir ranged from 0.06 to 0.85 mg/kg, but concentrations in the water column were was generally < 1 mg/L. Mean total nitrogen concentration in the Reservoir was 1.00 mg/L, much of it in dissolved form (mean concentration was 0.85 mg/L). Mean total organic nitrogen concentration in Calero Reservoir was 0.65 mg/L, and mean total nitrate concentration was 0.21 mg/L. Mean total phosphorus and dissolved orthophosphorous concentrations were 0.05 and 0.019 mg/L, respectively. Net primary productivity in the euphotic zone ranged from -2,000 to 10,000 mg of oxygen/sq m/day; the median value was 930. Carlson's trophic-state index, calculated using water transparency, total phosphorus, and chlorophyll-a values, indicated that the reservoir was eutrophic. Fecal coliform bacteria concentrations were < 20 colonies/100 ml in the reservoir and < 200 colonies/100 ml in the canal. Fecal streptococcal bacteria concentrations were generally < 45 colonies/100 ml in the reservoir and up to 260 colonies/100 ml in the canal. (Author's abstract)
W89-08648

STREAMFLOW AND WATER-QUALITY DATA FOR LAKE AND WETLAND INFLOWS AND OUTFLOWS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1981-82,
Geological Survey, St. Paul, MN. Water Resources Div.
L. Nelson, and R. G. Brown.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-543, 1983. 182p, 84 fig, 74 tab, 18 ref.

Descriptors: *Lakes, *Water quality, *Streamflow, *Minnesota, Seasonal variation, Bryant Lake, Lake Elmo, Fish Lake, Lake George, Lake Riley, Spring Lake, Square Lake, Rainfall, Suspended solids, Nutrients, Phosphorus, Nitrogen, Nitrates, Nitrites, Ammonia.

A study of runoff to selected lakes was done in the Twin Cities, Minnesota, metropolitan area from July 1981 to December 1982. The purpose of the study was to determine differences in nutrient loading characteristics for lakes with and without wetlands and settling ponds. The study also quantified nutrient loading to lakes on a storm, seasonal, and annual basis, complementing an in-lake water quality study done by the Metropolitan Council. Discharge and water quality data were collected periodically during 1981 and continuously during 1982 at 22 sites located in seven lake watersheds--Bryant Lake, Lake Elmo, Fish Lake, Lake George, Lake Riley, Spring Lake, and Square Lake. Basin characteristics and land use were determined for each watershed. Recording instruments provided continuous discharge records at 13 sites and continuous rainfall records at six sites. Automatic water quality samplers were used at lake inlets, collecting samples at 1- to 2-hour inter-

vals during storms. Lake outlet samples were collected manually on a weekly basis during flow. Samples were analyzed for suspended solids and nutrients. Atmospheric input data were collected at eight sites from September 23 to November 1, 1982. Discharge and water quality data were used to calculate storm, seasonal, and annual loads of total suspended solids, volatile suspended solids, total phosphorus, dissolved phosphorus, nitrite-plus-nitrate nitrogen, and ammonia-plus-organic nitrogen. All data collected during the study are documented in tables and graphs that contain: (1) watershed characteristics and land use; (2) storm concentrations; (3) storm, seasonal, and annual loads; (4) storm hydrographs; (5) atmospheric-input concentrations and loads; (6) storm, seasonal, and annual precipitation totals; and (7) results of quality-assurance tests. (Author's abstract)
W89-08663

LIMNOLOGY OF NINE SMALL LAKES, MATANUSKA-SUSITNA BOROUGH, ALASKA, AND THE SURVIVAL AND GROWTH RATES OF RAINBOW TROUT,
Geological Survey, Anchorage, AK. Water Resources Div.
P. F. Woods.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4292, 1985. 32p, 12 fig, 8 tab, 24 ref.

Descriptors: *Limnology, *Rainbow trout, *Lakes, *Alaska, Fish populations, Fish growth, Phosphorus, Chlorophyll a, Turbidity, Dissolved oxygen, Fishkill, Productivity.

The survival and growth rates of rainbow trout (Salmo gairdnieri) were concurrently measured with selected limnological characteristics in nine small (surface area < 25 sq hectometers) lakes in the Matanuska-Susitna Borough. The project goal was to develop empirical models for predicting rainbow trout growth rates from the following variables: total phosphorus concentration, chlorophyll a concentration, Secchi disc transparency, or the morphoedaphic index--a means of characterizing potential biological productivity. No suitable model could be developed from the data collected during 1982 and 1983. The lack of significant correlation was attributed in part to the wide variation in survival of rainbow trout. Winterkills, caused by severe depletion of dissolved oxygen, were suspected in four of the lakes. Varied levels of fishing pressure and competition with threespine stickleback (Gasterosteus aculeatus) also influenced survival of rainbow trout but their effects were overshadowed by winterkill. Predictive capability was also reduced because of inconsistencies in rankings generated by each of the four limnological variables chosen as indicators of potential biological productivity. A lake ranked low in productivity by one variable was commonly ranked high in productivity by another variable. The survivability of rainbow trout stocked in lakes such as these nine may be a more important indicator of potential biomass production than are indicators of lake fertility. Assessments of a lake's susceptibility to winterkill and the degree of competition with threespine stickleback are suggested as important topics for additional research. (Author's abstract)
W89-08671

QUALITY OF WATER AND BED MATERIAL IN STREAMS OF LOGAN TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY, 1984,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08679

TRANSPORT AND VARIABILITY OF INDICATOR BACTERIA IN THE APALACHICOLA RIVER AND ESTUARY, FLORIDA, 1983-84,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08684

EVALUATION OF COAL-MINING IMPACTS USING NUMERICAL CLASSIFICATION OF BENTHIC INVERTEBRATE DATA FROM STREAMS DRAINING A HEAVILY MINED BASIN IN EASTERN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08686

DETERMINATION OF REAERATION-RATE COEFFICIENTS OF THE WABASH RIVER, INDIANA, BY THE MODIFIED TRACER TECHNIQUE,
Geological Survey, Indianapolis, IN. Water Resources Div.
C. G. Crawford.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4290, 1985. 71p, 19 fig, 31 tab, 28 ref.

Descriptors: *Indiana, *Reaeration, *Wabash River, *Tracers, Streamflow, Ethylene, Aeration, Statistical analysis, Rivers.

The modified tracer technique was used to determine reaeration-rate coefficients in the Wabash River in reaches near Lafayette and Terre Haute, Indiana, at streamflows ranging from 2,310 to 7,400 cu ft/sec. Chemically pure (CP grade) ethylene was used as the tracer gas, and rhodamine-WT dye was used as the dispersion-dilution tracer. Reaeration coefficients determined for a 13.5-mi reach near Terre Haute, Indiana, at streamflows of 3,360 and 7,400 cu ft/sec (71% and 43% flow duration) were 1.4/day and 1.1/day at 20 C, respectively. Reacration-rate coefficients determined for a 18.4-mile reach near Lafayette, Indiana, at streamflows of 2,310 and 3,420 cu ft/sec (70% and 53% flow duration), were 1.2/day and 0.8/day at 20 C, respectively. None of the commonly used equations found in the literature predicted reaeration-rate coefficients similar to those measured for reaches of the Wabash River near Lafayette and Terre Haute. The average absolute prediction error for 10 commonly used reaeration equations ranged from 22% to 154%. Prediction error was much smaller in the reach near Terre Haute than in the reach near Lafayette. The overall average of the absolute prediction error for all 10 equations was 22% for the reach near Terre Haute and 128% for the reach near Lafayette. Confidence limits of results obtained from the modified tracer technique were smaller than those obtained from the equations in the literature. (Author's abstract)
W89-08687

WATER BUDGET AND ESTIMATED SUSPENDED-SEDIMENT INFLOW FOR REELFOOT LAKE, OBION AND LAKE COUNTIES, NORTHWESTERN TENNESSEE, MAY 1984-APRIL 1985,
Geological Survey, Nashville, TN. Water Resources Div.
C. H. Robbins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4284, 1985. 1p, 20 fig, 1 tab, 10 ref.

Descriptors: *Hydrologic budget, *Reelfoot Lake, *Suspended sediments, *Tennessee, Hydrologic data collections, Surface-groundwater relations, Sedimentation.

Reelfoot Lake in northwestern Tennessee, with a surface area of 15,500 acres at normal pool elevation, is the largest natural lake in Tennessee. Over the years, the lake has become an important economic, environmental, and recreational resource to the people in the area, and to the State of Tennessee. The natural eutrophic succession rate of the lake has apparently been accelerated by land use practices within the Reelfoot Lake drainage basin during the past several decades. The potential loss of Reelfoot Lake has prompted the State to make management and restoration of the lake and its resources a priority objective. The U.S. Geological Survey entered into a cooperative study in May 1984 with the Tennessee Wildlife Resources Agency and the Tennessee Department of Health and Environment, Division of Water Management, to collect and analyze hydrologic data and prepare an annual water budget for Reelfoot Lake. The purpose of the water budget is to provide an analysis of the surface-groundwater-lake-atmospheric water relation at Reelfoot Lake. Results of the analysis can be used by lake managers to evaluate the potential effects of proposed lake management strategies upon the lake and surrounding hydrologic system. The water budget for the 12-month study period (May 1, 1984 through April 30, 1985) is presented in this report. In addition, estimates of suspended-sediment discharge from tributary streams in the Reelfoot Lake basin and an analysis of concentrations of constituents in stream-bottom material at three inflow sites are also presented. (Lantz-PTT)
W89-08689

WATER-QUALITY OF LAKE CONROE ON THE WEST FORK SAN JACINTO RIVER, SOUTHEASTERN TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
M. W. Flugrath, F. L. Andrews, and E. M. McPherson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4301, 1985. 153p, 17 fig, 32 tab, 14 ref.

Descriptors: *Thermal stratification, *Lake Conroe, *Water quality, *San Jacinto River, *Texas, Dissolved oxygen, Iron, Manganese, Phosphorus, Seasonal variation, Reservoirs, Stratification, Lakes, Algae.

Thermal stratification in Lake Conroe, Texas usually begins to develop in March and persists until October. Thermal stratification has resulted in significant seasonal and areal variations in the concentrations of dissolved oxygen, dissolved iron, dissolved manganese, total inorganic nitrogen, and total phosphorus. Volume-weighted-average concentration of dissolved solids generally was < 120 mg/L, that of dissolved chloride generally was < 22 mg/L, and that of dissolved sulfate was < 10 mg/L in Lake Conroe during the 1973-82 water years. The concentrations of each of these constituents usually were largest during the summer. The water was moderately hard (hardness > 60 but < 120 mg/L as calcium carbonate). The average concentrations of dissolved oxygen at most sites in the downstream one-half of the lake averaged 3.2 mg/L during summer stratification and > 9 mg/L during winter circulation. The concentrations at most sites in the headwaters of the lake averaged < 4.3 mg/L during the summer and < 7.9 mg/L during the winter. Water below depths of 25 to 35 ft usually contained < 1 mg/L dissolved oxygen during the summer. The concentrations of dissolved iron and dissolved manganese in water throughout the reservoir during winter circulation and in water near the reservoir surface during summer stratification were < 100 micrograms/L. The greatest concentration occurred during summer stagnation near the reservoir bottom at a deep site near Lake Conroe Dam. The concentrations of total inorganic nitrogen and total phosphorus were greatest during summer stratification in water near the reservoir bottom at deep sites. No accumulation of these constituents within the reservoir was detected during the study. The densities and composition of algal populations varied seasonally. Algal densities were greatest during the summer with blue-green algae being the predominant phylum. (Author's abstract)
W89-08691

EFFECTS OF WETLANDS ON QUALITY OF RUNOFF ENTERING LAKES IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08749

HYDROLOGIC FACTORS AFFECTING LAKE-LEVEL FLUCTUATIONS IN BIG MARINE LAKE, WASHINGTON COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
R. G. Brown.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4176, 1985. 23p, 13 fig, 1 tab, 14 ref.

Descriptors: *Surface-groundwater relations, *Minnesota, *Hydrology, *Lakes, Big Marine Lake, Water level fluctuations, Evaporation, Precipitation, Groundwater discharge, Aquifers, Potentiometry, Recharge, Flooding.

A study by the U.S. Geological Survey from 1981 through 1984, in cooperation with the Carnelian-Marine Watershed District and the Minnesota Department of Natural Resources, investigated the causes of large lake level fluctuations at Big Marine Lake. Historic records document that Big Marine Lake has changed substantially in surface area during the period 1847 through 1983; the maximum lake surface area was 2,300 acres in 1847, and the minimum lake surface area was 890 acres in 1938. A change in lake level of about 11 ft caused these changes in surface area. Serious flooding of lake shore properties has occurred in recent years because residential development commonly took place during periods of relatively low lake level during the 1950's and 1960's. Evaporation from the lake was estimated to be approximately equal to incident precipitation on the lake surface on an annual basis. Big Marine Lake does not have a surface water inlet, and the outlet from the lake is at an elevation well above the stage at which lake shore property is flooded. Geohydrologic and geochemical data collected during the study show that: (1) fluctuation of water levels at Big Marine Lake is controlled primarily by groundwater discharge to and seepage from the lake; (2) water in the drift aquifer and water in the lake are chemically similar; and (3) changes in the potentiometric surface of the bedrock aquifer have minor effects on changes in lake level. Long-term trends in cumulative departure from mean annual precipitation suggest that recharge to the drift aquifer in the area has been increasing since the 1940's. The increase in precipitation and recharge corresponds to the observed rise in lake level since 1965 when regular lake level measurements began. Fluctuations in lake level in the future will depend on changes in recharge to the drift and bedrock aquifers, which is directly related to changes in long-term precipitation patterns. (Author's abstract)
W89-08753

CLUSTER ANALYSIS OF PHYTOPLANKTON DATA COLLECTED FROM THE NATIONAL STREAM QUALITY ACCOUNTING NETWORK IN THE TENNESSEE RIVER BASIN, 1974-81,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08780

HYDROLOGIC CONDITIONS IN CONNORS BOG AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Glass.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4044, 1986. 23p, 4 fig, 5 tab, 16 ref.

Descriptors: *Bogs, *Connors Bog, *Wetlands, *Hydrological regime, *Alaska, Groundwater movement, Precipitation, Evapotranspiration, Leachates, Path of pollutants, Dissolved solids, Aquifers, Potentiometric level, Wildlife habitats, Water quality.

Connors Bog is a wetland in Anchorage, Alaska, which provides a habitat for many wildlife species and is a popular area for driving off-road vehicles. A landfill, and residential and commercial developments are present in areas which were once wetland. The main source of water is precipitation, which averages about 15 in/yr. Estimates of evapotranspiration, which is the main component of water outflow, range from 10 to 20 in/yr. Minor amounts of groundwater and surface runoff flow into the area from the northeast and southwest and flow out of the area to the northwest and south. Within the wetland, water in peat and sand is unconfined and becomes more mineralized with depth. A leachate beneath and near an abandoned landfill is characterized by concentrations of dissolved solids, dissolved chloride, and total organics that are higher than those of the area's natural water. The maximum lateral extent of detectable contamination in 1984 was < 500 ft from the landfill's edge. Water in glacial deposits that underlie a poorly permeable layer of silt and clay is confined. A well completed in this confined aquifer yielded water that had a low concentration of dissolved solids, 150 mg/L. The potentiometric surface of this aquifer was about 20 ft lower than the water table during 1984. Connors Lake occupies a depression that extends below adjacent groundwater levels. The 40-acre lake has a maximum depth of about 9 ft and a low rate of biological production. The quality of water in the lake has not been adversely impacted by nearby residential development or landfill operations. Lake levels appear to be influenced by precipitation and adjacent groundwater levels. (Author's abstract)
W89-08793

SIMULATION OF UNSTEADY FLOW IN THE MILWAUKEE HARBOR ESTUARY AT MILWAUKEE, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
L. B. House.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4050, March 1987. 19p, 5 fig, 10 tab, 1 plate, 5 ref.

Descriptors: *Harbors, *Lake Michigan, *Simulation analysis, *Unsteady flow, *Milwaukee Harbor, *Estuaries, *Wisconsin, Flow profiles, Model studies, Flow discharge, Mathematical models, Mathematical equations.

This report describes the application and results of an unsteady-flow model for the Milwaukee Harbor Estuary. The model simulates unsteady and upstream flow occurring in the estuary as a result of Lake Michigan Seiche. The discharge computed by the model indicates that upstream flow occurs throughout the estuary during periods of lake seiche. Flow conditions are extremely unsteady and major flow reversals may occur within 1 hr. The simulated discharge indicates that both upstream and downstream flows four times greater than the average daily discharge can occur during the same day. An estimate of 5- or 15-minute average discharge was required during selected runoff events and at various locations in the estuary as part of the Milwaukee Harbor Estuary study. The model provides a method to estimate 5-minute average discharges at selected cross sections in the estuary. The U.S. Geological Survey's Branch Network Model was used to simulate stage and discharge. A finite difference computation scheme is used to solve the one-dimensional flow equations. Model input requirements include channel geometry data, discharge at the upstream tributaries, and stage data at the estuary mouth. The model was used to simulate the flow during six selected time periods in 1982-84 using a 5- or 15-minute computation interval. (Author's abstract)
W89-08798

STUDY FOR REAL TIME OPERATION OF FOUR FLOOD RESERVOIRS,
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
For primary bibliographic entry see Field 4A.
W89-08894

RESERVOIR SEDIMENTATION AND INFLUENCE OF FLUSHING,
For primary bibliographic entry see Field 2J.
W89-08961

EFFECT OF GLACIER ABLATION ON THE SNETTISHAM HYDROELECTRIC PROJECT, LONG LAKE AND CRATER LAKE BASINS, ALASKA WITH A SECTION ON STREAMFLOW RECORDS,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09021

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
W. J. Nichols, J. A. Smath, and J. T. Adamik.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-866, November 1983. 43p, 3 fig, 13 tab, 6 ref.

Descriptors: *Hydrologic data collections, *Data acquisition, *Hydrologic data, *Great Heath, *Denbow Heath, *Maine, Precipitation, Evaporation, Air temperature, Streamflow, Groundwater level, Water quality, Peat bogs, Piezometers, Hydrogen ion concentration, Specific conductivity, Organic compounds.

Hydrologic data collected on the Great and Denbow Heaths, Maine, include precipitation, pan evaporation, air temperatures, streamflow, groundwater levels, and water quality constituents. These data were collected for a peat bog hydrology study conducted in cooperation with the Maine Geological Survey. The data network consisted of climate information from three rain gages, an evaporation pan, and two maximum-minimum thermometers; surface water information from two continuous gaging stations and 19 partial record sites; groundwater information from an observation well equipped with a continuous recorder and 106 piezometers; and water quality information from 13 wells and seven surface water sites. Water quality constituents include: field determinations of pH, specific conductance, and temperature, and laboratory determinations of common inorganic cations and anions, trace elements, and selected organic compounds. Methods used for the collection and analyses of data included standard Survey techniques modified for the unique hydrologic environment of the study area. (Author's abstract)
W89-09073

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1981 THROUGH OCTOBER 1982,
Geological Survey, Augusta, ME. Water Resources Div.
W. J. Nichols.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-865, November 1983. 29p, 3 fig, 9 tab, 5 ref.

Descriptors: *Hydrologic data collections, *Data collections, *Hydrologic data, *Peat bogs, *Data acquisition, *Denbow Heath, *Great Heath, *Maine, Precipitation, Evaporation, Air temperature, Streamflow, Groundwater level, Water quality, Piezometers, Hydrogen ion concentration, Specific conductivity, Organic compounds.

Hydrologic data collected on the Great and Denbow Heaths, Maine, include precipitation, pan evaporation, air temperatures, streamflow, and ground water levels. These data were collected for a peat bog hydrology study conducted in cooperation with the Maine Geological Survey. The data network consisted of climate information from three rain gages, an evaporation pan and two maximum-minimum thermometers; surface water information from two continuous gaging stations and 19 partial record sites; groundwater information from an observation well equipped with a continuous recorder and 106 piezometers. Methods used for the collection and analyses of data included stand-

ard Survey techniques modified for the unique hydrologic environment of the study area. (Author's abstract)
W89-09074

HYDROLOGIC DATA FOR THE DRAINAGE BASINS OF CHATFIELD AND CHERRY CREEK LAKES, DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09077

CAPACITY AND SEDIMENTATION OF LOCH LOMOND RESERVOIR SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09095

ESTIMATES OF GAINS AND LOSSES FOR RESERVOIRS ON THE SNAKE RIVER FROM BLACKFOOT TO MILNER, IDAHO, FOR SELECTED PERIODS, 1912 TO 1983,
Geological Survey, Boise, ID. Water Resources Div.
L. C. Kjelstrom.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4063, 1988. 62p, 27 fig, 8 tab, 23 ref.

Descriptors: *Irrigation water, *Semiarid lands, *Reservoir storage, *Snake River, *American Falls Reservoir, Idaho, Reservoir, Lake Walcott, Milner Lake, Reservoir yield, Hydrologic budget, Reservoir stage, Discharge, Streamflow, Reservoirs.

Croplands in the semiarid central part of the Snake River Plain are dependent on the availability of irrigation water, most of which comes from the Snake River. Allocation of irrigation water from the river requires that gains and losses be determined for American Falls Reservoir, Lake Walcott, and Milner Lake. From 1912 to 1983, average ungaged inflow to American Falls Reservoir, determined from monthly water budgets, was 2,690 cu ft/sec. About 94% of this inflow was spring discharge and groundwater seepage; the remainder was from small tributaries and irrigation-return flow. Ungaged inflow estimated from water budgets for various periods correlated favorably with measured discharge of two springs and water levels in two wells. Discharge of Spring Creek was a better indicator of ungaged inflow than groundwater levels. Therefore, correlation with Spring Creek discharge was used in estimating ungaged inflow to American Falls Reservoir in 1983. Daily water budget calculations of ungaged inflow to American Falls Reservoir are less variable when storage changes are determined by using three stage-recording stations rather than one. Water budgets do not indicate large amounts of leakage from American Falls Reservoir, but small amounts of leakage are indicated because flow in downstream springs increased about 25% after reservoir storage began in 1926. Water budgets for Lake Walcott and Milner Lake show average annual net gains (1951-83) to Lake Walcott and Milner Lake of 245 and 290 cu ft/sec. These amounts are verified by monthly water budgets when discharge in the Snake River is low, and measured and estimated sources of inflow. Gains and losses estimated from daily water budgets are variable, owing to inadequate determination of (1) changes in reservoir storage, (2) streamflow, (3) lake surface precipitation, and (4) lake surface evaporation. Backwater effects are accounted for in the process used to determine storage in Milner Lake. (Author's abstract)
W89-09184

BIOLOGICAL, MORPHOLOGICAL, AND CHEMICAL CHARACTERISTICS OF WAILUKU RIVER, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
J. J. S. Yee, and C. J. Ewart.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4043, April 1986. 69p, 22 fig, 15 tab, 35 ref.

Descriptors: *Biological properties, *Channel morphology, *Chemical properties, *Wailuku River, *Hawaii, *Water quality, Benthic environment, Phytoplankton, Periphyton, Coliforms, Bacteria, Particle size, Hydrogen ion concentration, Turbidity, Specific conductivity, Dissolved oxygen, Nitrogen, Phosphorus.

Biological, morphological, and chemical data on Wailuku River were collected to assess its water quality characteristics. Biological measurements included evaluation of benthic invertebrates, periphyton, phytoplankton and coliform bacteria. Morphological measurements consisted of channel surveys and particle size determination of bed materials. Chemical quality measurements, made monthly at two sampling stations, included water temperature, pH, specific conductance, dissolved solids concentration, turbidity, dissolved oxygen, nitrogen, phosphorus, and minor elements. Biological and chemical data indicated relatively clean water compared to similar streams in conterminous United States. The number and types of benthic organisms are low in Wailuku River. This is due mainly to channel gradient and flow velocities rather than to chemical toxicity. Periphyton data also indicate unpolluted water of low to moderate primary productivity. Diatoms are the dominant organisms observed in the periphyton samples. Coliform bacteria densities are typical of mountain streams in Hawaii that are essentially unaffected by human activities. The streambed is formed of lava flows from Mauna Loa volcano, and the stream channel is characterized by a series of plunge pools and waterfalls. The longitudinal slope ranges from 5% at midreaches to 8% at the headwater regions. There is no broad flood plain at the mouth of the stream. The stream channel is generally a narrow steep-sided trapezoid with an irregular base. Streambanks are composed of fine to very coarse-grained material. Channel depth increases from 6 ft at the headwaters to 40 ft at Hilo. The width also increases from 60 ft at the highest study site to 220 ft at the Hilo site near the mouth of the river. (Author's abstract)
W89-09196

CLIMATIC DATA FOR WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA, 1982,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09201

DAMS, RESERVOIRS AND WITHDRAWALS FOR WATER SUPPLY--HISTORIC TRENDS,
Geological Survey, Reston, VA. Water Resources Div.
W. B. Langbein.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-256, 1982. 9p, 2 fig, 1 tab, 8 ref.

Descriptors: *Dams, *Reservoir capacity, *History, Reservoirs, Reservoir storage, Water supply.

The U.S. Geological Survey (USGS) from time to time has published an inventory of major reservoirs and controlled natural lakes. The latest available USGS report indicated that as of 1963, usable capacity in major reservoirs (those having 5,000 acre-ft of usable capacity) totaled 359 million acre-ft. The growth rate for total capacity averaged about 80%/decade until the early 1960's. Since then, reservoir capacity has increased at a markedly slower rate, the effects of approaching an asymptotic limit on capacity in some areas, compounded, by increasing public aversion toward reservoir construction. The trend toward non-structural measures places greater dependence on management skill and on better forecasts. At some point, the potentials of conservation and better management will become less effective than reservoirs and there will again be an upward trend in reservoir capacity. (Lantz-PTT)
W89-09220

PLANKTON STUDIES IN SAN FRANCISCO BAY. IV: PHYTOPLANKTON ABUNDANCE AND SPECIES COMPOSITION, JANUARY 1980-FEBRUARY 1981,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. L. J. Wong, and J. E. Cloern.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-443, April 1982. 152p, 1 fig, 1 tab, 8 ref, 4 append.

Descriptors: *Plankton, *Species diversity, *California, *San Francisco Bay, *Phytoplankton, Population density, Biological studies.

Data are presented on the phytoplankton species composition and abundance in San Francisco Bay from January 1980 through February 1981. Phytoplankton were identified and enumerated in surface samples collected approximately every two weeks at selected stations in the main channel of the Bay, and at shoal stations in the central portion of South San Francisco Bay, San Pablo Bay, and Suisun Bay. Also reported are separate species lists for microphytoplankton (< 60 micrometers) and macrophytoplankton (> 60 micrometers). (Author's abstract)
W89-09221

FILLING OF SPIRIT LAKE, WASHINGTON, MAY 18, 1980, TO JULY 31, 1982,
Geological Survey, Tacoma, WA. Water Resources Div.
W. Meyer, and P. J. Carpenter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 82-771, 1983. 19p, 6 fig, 1 tab, 3 ref.

Descriptors: *Lakes, *Volcano effects, *Debris dams, *Spirit Lake, *Washington, *Mount St Helens, Water level, Dams, Precipitation, Water storage, Dam failure, Erosion.

The rockslide/debris avalanche from the north face of Mount St. Helens that precipitated the volcano's eruption on May 18, 1980, blocked outflow from Spirit Lake, Washington. There has been no surface outflow since that time. From May 21, 1980, when the first measurement of lake level was made, to August 1, 1982, Spirit Lake has increased its volume from 122,800 acre-ft to 264,000 acre-ft, an increase of 115%. Lake level has risen approximately 54 ft during this period. Hydrologic and geologic properties of the debris dam are unknown, but the materials obviously are easily erodible. Steep walled channels up to 60 ft deep have been eroded into the dam and are extending headward toward the lowest points on the crest. In addition, it appears that the lower areas on the crest of the dam are underlain by ash cloud deposits of low density. Indications are that the debris dam could fail by headward erosion, by overtopping with rapid downcutting, or by 'piping' and rapid erosion. Each type of failure can produce rapid release of stored lake water with very high discharge rates. On the basis of observed filling rates of the lake over the last two yr and precipitation records at four long-term, low altitude National Weather Service stations, it is expected that normal precipitation will fill the lake to the dam crest in December 1985. This estimate is also based on the assumption that loss of water from the lake by seepage continues at the present rate until December 1985. With normal precipitation during the coming yr (August 1982 through July 1983 the lake will fill to a level 50 ft below the lowest existing point on the crest of the debris dam, which is at 3,532 ft altitude. If precipitation exceeds normal by 1.5 times during this coming year, the lake level will be 40 ft below the 3,532-ft crest of the debris dam by the end of July 1983. This same lake level can be reached by the end of March 1983 if precipitation from October through March is twice the winter mean. (Author's abstract)
W89-09224

INDEX TO LIMNOLOGICAL DATA FOR SOUTH-CENTRAL ALASKA LAKES,
Geological Survey, Anchorage, AK. Water Resources Div.
M. A. Maurer, and P. F. Woods.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-529, 1987. 146p, 203 ref.

Descriptors: *Limnological data, *Information retrieval, *Indexing, *Limnology, *Hydrologic data collections, *Alaska, *Lakes, *Eutrophication, Water quality, Hydrologic data.

South-central Alaska lakes are a valuable natural resource and provide a variety of recreational opportunities to the public. Lakeside development has increased significantly in the past 10 years and several south-central Alaskan lakes have documented pollution problems. Cultural eutrophication, the process by which man-induced nutrient loading to a lake results in large increases in biological productivity, can also produce noxious algae blooms, dissolved oxygen depletion at depth, reduced water transparency, and fish kills. The potential for cultural eutrophication of south-central Alaska lakes prompted the U.S. Geological Survey (USGS) Water Resources Division and the Alaska Department of Natural Resources-Division of Geological and Geophysical Surveys (ADGGS) to provide lake researchers, managers, and the public with this index of published historical and current limnological references. The purpose of the index is to provide reference to the data which can be used to identify and monitor cultural eutrophication of south-central Alaska lakes. (Lantz-PTT)
W89-09269

2I. Water In Plants

ALGAE AND HUMAN AFFAIRS.
For primary bibliographic entry see Field 2H.
W89-08612

OSMOTIC POTENTIAL AND PROJECTED DROUGHT TOLERANCE OF FOUR PHREATOPHYTIC SHRUB SPECIES IN OWENS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
P. D. Dileanis, and D. P. Groeneveld.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-77, 1988. 45p, 9 fig, 4 tab, 50 ref.

Descriptors: *Plant water potential, *Drought, *Drought resistance, *Shrubs, *Soil-water-plant relationships, *Phreatophytes, *California, Osmotic pressure, Groundwater budget, Plant physiology, Water table, Moisture stress, Aquifers.

A large part of the water used by plant communities growing on the floor of Owens Valley, California, is derived from a shallow unconfined aquifer. Fluctuations in the water table caused by groundwater withdrawal may result in periods when this water supply is not accessible to plants. The capacity of the plants to adapt to these periods of water loss depend on the availability of water stored in the soil and on physiological characteristics related to the ability of the plants to resist dehydration and wilting. Osmotic adjustment occurred in four phreatophytic shrub species at sites near bishop, California, where the water table had been lowered by a system of pump-equipped wells installed in the vicinity of vegetation transects. The pressure-volume techniques was used to determine osmotic potential and cell-wall elasticity between March 1985 and September 1986 for Atriplex torreyi, Chrysothamnus nauseosus, Sarcobatus vermiculatus, and Artemisia tridentata. Although not usually classified as a phreatophyte, Artemisia tridentata, where it grows on the valley floor, is apparently dependent on the depth to the water table. During late summer, osmotic potentials were 0.37 to 0.41 megapascal lower in plants growing on the site where the water table had been lowered compared to an adjacent site where the water table remained at its natural levels. Measurements of soil matric potential at the two sites indicated that osmotic adjustment occurred in response to stress caused by lowering the water table. A theoretical lower limit of osmotic adjustment was determined by comparing initial cell osmotic potentials with initial xylem water potentials. These experimentally derived limits indicated that A. torreyi and S. vermiculatus may maintain leaf cell turgor at significantly lower cell water potentials (about -4.5 megapascals) than C. nauseosus or A. tridentata (about -2.5 megapascals) and allows them to function in dryer soil environments. (Author's abstract)
W89-08640

ESTIMATING SOIL MATRIC POTENTIAL IN OWENS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2G.
W89-09198

2J. Erosion and Sedimentation

ANALYSIS OF BANK PROTECTION USING A PROBABILITY OF MOTION APPROACH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W89-08253

INTERACTION BETWEEN ESTUARINE PLUMES AND CONTINENTAL SHELF WATERS,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2L.
W89-08255

NUMERICAL MODEL OF WATERSHED EROSION AND SEDIMENT YIELD,
Arizona Univ., Tucson. School of Renewable Natural Resources.
V. L. Lopes.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8711635. Ph.D. Dissertation, 1987. 148p, 46 fig, 11 tab, 127 ref, 2 append.

Descriptors: *Numerical analysis, *Model studies, *Soil erosion, *Sediment yield, *Erosion control, Watersheds, Mathematical models, Computer programs, Computer models, Simulation analysis, Rainfall infiltration, Surface runoff, Runoff rates, Deposition.

A numerical model for watershed erosion and sediment yield was developed based on infiltration processes, unsteady surface runoff hydraulics, and fundamental erosion and deposition mechanics. For application of the model, the Watershed Erosion Simulation Program (WESP) was also developed. Parameter estimation techniques and model testing procedures are described using data from runoff-erosion plots and small watersheds. The applicability of the erosion parameters estimated from rainfall simulator plots when applied to a watershed scale under a variety of rainfall inputs and antecedent soil moisture conditions was verified using data collected on two small experimental watersheds. The modular structure of the WESP computer program will facilitate substitution of different components and subroutines. The good agreement between the simulated and the observed watershed response indicates that the governing equations, initial and upper boundary conditions, and structural framework of the model can described satisfactorily the physical processes controlling watershed response. (Cremmins-AEPCO)
W89-08260

METHOD OF PRODUCING AND LAYING A BARRIER STRUCTURE,
For primary bibliographic entry see Field 8A.
W89-08288

METHOD OF CAUSING SEDIMENTATION OF SEDIMENTARY SOLID MATERIAL TRANSPORTED IN A BODY OF WATER, SUCH AS A LAKE, A SEA, OR AN OCEAN,
Geoteknisk Inst., Lyngby (Denmark).
For primary bibliographic entry see Field 4D.
W89-08293

SEDIMENT INFLOW, OUTFLOW, AND DEPOSITION FOR LAKES MARION AND MOULTRIE, SOUTH CAROLINA OCTOBER 1983 - MARCH 1985,
Geological Survey, Columbia, SC. Water Resources Div.
T. W. Cooney.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4160, Dec 1988. 49p, 4 fig, 19 tab, 14 ref.

Descriptors: *Bed load, *Lake Marion, *Lake Moultrie, *Santee River, *Sediment yield, *South Carolina, *Suspended load, *Trap efficiency, Congaree River, Particle size, Sediment concentration, Streamflow, Wateree river.

In 1941 a Coastal Plain reach of the Santee River was impounded to form Lake Marion and diverted into a diked-off part of the Cooper River basin to form Lake Moultrie. Rates of sediment inflow and outflow of the lakes were determined by the U.S. Geological Survey for the periods July 1966 - June 1968 and October 1983 - March 1985. Total sediment discharge was estimated for two inflow stations and continuous streamflow monitors and automatic suspended-sediment samplers were used for computation of suspended-sediment discharge. Bedload discharge was computed by the modified Einstein procedure. Suspended-sediment discharge was monitored at three outflow stations, with the suspended-sediment concentration measured on a weekly basis. During the 1983-1985 study, mean annual suspended-sediment inflow to Lakes Marion and Moultrie was estimated to be 722,000 tons, and the outflow was estimated at 175,000 tons, for a trap efficiency of 76% and a deposition rate of about 547,000 tons/year. This is about 33% less than the deposition rate determined during the 1966-68 study. The deposition rate for suspended and bedload sediment during the 1983 - 1985 study was about 650,000 tons/year. (USGS)
W89-08358

COMPARISON OF SEDIMENT TRANSPORT FORMULAS AND COMPUTATION OF SEDIMENT DISCHARGES FOR THE NORTH FORK TOUTLE AND TOUTLE RIVERS, NEAR MOUNT ST. HELENS, WASHINGTON,
Geological Survey, Vancouver, WA. Water Resources Div.
S. E. Hammond.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-463, (1988). 30p, 11 fig, 4 tab, 18 ref.

Descriptors: *Bed-material discharge, *Bed-load discharge, *Bed-load measurements, *Sediment transport, *Transport formulas, Helley-Smith bedload sampler, Mount St. Helens, Suspended-sediment discharge, Toutle River, Washington, Water discharge.

This preliminary report presents results of computations using twelve different sediment discharge formulas along with data from two data collection sites in the Toutle River basin. Output from six bed material discharge formulas and six bedload discharge formulas was considered. The results of the computations are presented graphically for comparison purposes only. In addition to output from the formulas, the results from suspended-sediment samples and several bedload measurements using a Helley-Smith type bedload sampler are presented. No interpretation of the output is provided. (USGS)
W89-08376

FIELD AND LABORATORY DATA DESCRIBING PHYSICAL AND CHEMICAL CHARACTERISTICS OF METAL-CONTAMINATED FLOOD-PLAIN DEPOSITS DOWNSTREAM FROM LEAD, WEST-CENTRAL SOUTH DAKOTA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08405

HISTORY OF SUSPENDED SEDIMENT DATA COLLECTION AND INVENTORY OF AVAILABLE DATA FOR THE TENNESSEE AND CUMBERLAND RIVER BASINS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08416

DEVELOPMENT OF A SEDIMENT TRANSPORT MODEL FOR FIELD APPLICATIONS,
Mississippi Univ., University. Center for Computational Hydroscience and Engineering.
S. S. Y. Wang.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136865/AS, price codes: A03 in paper copy; A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1431-06, July 1988. 24p, 21 fig, 40 ref. USGS contract 14-34-0001-G1431. USGS project G1431-06.

Descriptors: *Sedimentation, *Mathematical modeling, *Model studies, Sediment transport, Hydrodynamics, Soil, Mathematical models.

This project is to develop a numerical-empirical model for better understanding of the sedimentation process in water resources systems. Due to the complexities of sedimentation phenomena, there is no exact mathematical solution and the traditional physical modeling has been found to be more and more costly in terms of funds and especially time as more and more parameters must be included into the consideration. Therefore, more and more hydraulic engineers and researchers around the world are adopting the numerical-empirical methodology in seeking for the solutions to the engineering and management problems of water resources system. During the first year of this two-year project, individual computational models for simulating sedimentation phenomena in 1-d, 2-d, and 3-d hydraulic systems had been improved in accuracy, stability and efficiency. This year, the second and last of this two-year project, all of these basic models have been further refined and used as building blocks to construct a mixed-dimensional model to gain the cost-effectiveness of profound importance in field application of this new model. Two major break-throughs have been achieved. They are (1) the solution of the interface problems of continuity and compatibility at the boundary of two different models, and (2) the development of a new numerical approach, the 'Finite Vicinity Method.' With these major accomplishments included in an over-all computational model, the numerical-empirical simulation of a water resources system has become not only possible but also feasible economically. (USGS)
W89-08442

ATCHAFALAYA RIVER DELTA. REPORT 5: THE ATCHAFALAYA RIVER DELTA QUASI-TWO-DIMENSIONAL MODEL OF DELTA GROWTH AND IMPACTS ON RIVER STAGES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. A. Thomas, R. E. Heath, J. P. Stewart, and D. G. Clark.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A204 516, price codes: A08 in paper copy, A01 in microfiche. Technical Report HL-82-15, December 1988. Report 5 of a Series. 168p, 31 fig, 26 tab, 60 plates, 28 ref.

Descriptors: *Louisiana, *Atchafalaya River, *Mathematical models, *Deltas, *Sediment transport, *Model studies, Dredging, Sedimentation.

This report documents one task in a multidisciplinary study of the development of the Atchafalaya Delta. The purpose of this task was to predict the area of new subaerial land, the volume of sediment deposition in the bay, and the resulting change in flood elevations for a period of 50 years into the future. Because of the complex interactions of the many processes going on in this study area, four basically different approaches were planned for predicting delta growth, one of which is the development of processes-based numerical models which treat delta growth as a boundary value problem. These include: (1) quasi-two-dimensional sediment computation (HAD-1); (2) sediment transport in unsteady, two-dimensional flow, horizontal plane (STUDH and its companion hydrodynamic model, RMA-2V; and (3) a special treatment of the saline density currents, deep-water waves, and hurricane surges. This report documents the quasi-two-dimensional sediment computation approach and compares results to those determined by regression and generic analyses. The scope of this phase of the delta study is limited to forecasting rate of delta growth and the resulting impact on flood stages, maintenance dredging, and flow distribution for a do-nothing alternative. That is, if man's activities in the study area were to cease except for maintenance dredging for navigation, how much would the delta grow over the next 50 years. Later studies will address salinity and other alternatives for managing the land and water resources in the bay. The techniques being developed are designed to handle other alternatives, also. Because these techniques are intended for use by others, report describes their development and presents the bases for decisions made during their application in more detail than normally. (Lantz-PTT)
W89-08512

ANALYSIS OF SEDIMENT TRANSPORT IN THE BRAZOS RIVER DIVERSION CHANNEL ENTRANCE REGION,
Coastal Engineering Research Center, Vicksburg, MS.
M. L. Field, L. L. Weishar, and J. E. Clausner.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A193 979. Price codes: A06 in paper copy, A01 in microfiche. Miscellaneous Paper CERC-88-7, May 1988. Final Report. 130p, 43 fig, 18 tab, 50 ref, 2 append.

Descriptors: *Diversion channels, *Dredging, *Channel accretion, *Texas, *Sediment transport, *Brazos River, *Navigation channels, Channels, Shoals, Sedimentation rates, Mathematical models, Hydraulic models, Seasonal variation, Sedimentation, Mathematical studies.

A combined office and field study was conducted to evaluate the feasibility of constructing a navigation channel in the Brazos River Diversion Channel (BRDC). The evaluation was made through an analysis of existing data and a computation of shoaling rates. The office study consisted on an evaluation of the shoaling history of the area, which was determined through quantification of shoreline migration rates, and volumetric changes in the growth of the BRDC delta. Nearshore available longshore sediment transport quantities and rates were determined using Littoral Environment Observation data. A two-dimensional (2-D) laterally averaged numerical model was used to predict sediment transport in the BRDC for the proposed channel dimensions. A second 2-D numerical-wave refraction/diffraction model was used to predict wave propagation over the Brazos River ebb-tide delta and adjacent regions. Field data utilized to run the numerical models consisted of water surface elevations, current velocities, salinities, suspended sediment concentrations, nearshore sediment samples, and bathymetric survey data. Considerations of the hydraulics in the lower BRDC suggest sediment transport occurs on a seasonal basis, resulting in periodic flushing and shoaling conditions. Shoaling rate calculations for the proposed channel dimensions of 12-ft deep by 125-ft wide, with 6-ft overdredging predict an annual maintenance dredging requirement of 735,000 cu yd, with an estimated project duration of approximately 4 months. (Author's abstract)
W89-08554

MONITORING GEOMORPHOLOGICAL PROCESSES IN DESERT MARGINAL ENVIRONMENTS USING MULTITEMPORAL SATELLITE IMAGERY,
Reading Univ. (England).
For primary bibliographic entry see Field 7B.
W89-08581

SMALL SCALE EROSION HAZARD MAPPING USING LANDSAT INFORMATION IN THE NORTHWEST OF ARGENTINA,
For primary bibliographic entry see Field 7C.
W89-08583

SATELLITE REMOTE SENSING OF THE COASTAL ENVIRONMENT OF BOMBAY,
Indian Inst. of Tech., Bombay.
For primary bibliographic entry see Field 7C.
W89-08602

SEDIMENT DISCHARGE IN ROCK CREEK AND THE EFFECT OF SEDIMENTATION RATE ON THE PROPOSED ROCK CREEK RESERVOIR, NORTHWESTERN COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
D. L. Butler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4026, 1987. 23p, 6 fig, 7 tab, 14 ref.

Descriptors: *Sedimentation rates, *Reservoir silting, *Sediment discharge, *Rock Creek, *Reservoirs, *Water resources development, *Environmental effects, *Colorado, Rock Creek Reservoir, Suspended sediments, Stream discharge.

Sediment data collected from 1976 to 1985 and stream discharge data collected from 1952 to 1980 at gaging station 09060500, Rock Creek near Toponas, Colorado, were used to determine total sediment discharge into the proposed Rock Creek Reservoir. Suspended sediment discharge and bedload discharge were related to stream discharge by using logarithmic regression relations. Mean annual suspended sediment discharge was estimated to be 309 tons/yr, and mean annual bedload discharge was estimated to be 428 tons/yr in Rock Creek at the Toponas gaging station for the 1953 through 1980 water years. The mean annual total sediment discharge into the proposed reservoir was estimated to be 768 tons/yr, which includes 10% addition to the suspended sediment discharge calculated for the Toponas gaging station to account for suspended sediment discharge from Horse Creek. This rate of mean annual total sediment discharge would decrease the long-term water storage capacity of the proposed reservoir by < 1% after 100 years. Suspended sediment discharge/unit-drainage-basin area at gaging station 09060550, Rock Creek at Crater, located about 5 mi downstream for the proposed reservoir site, was equivalent to suspended-sediment discharge/unit-drainage-basin area at the Toponas gaging station during 1985. Long-term sediment data collection at the Crater gaging station could be used for detecting changes in suspended sediment discharge in Rock Creek at the proposed reservoir site. (Author's abstract)
W89-08623

TEST OF AN INFRARED LIGHT-EMITTING TURBIDIMETER,
For primary bibliographic entry see Field 7B.
W89-08641

DESCRIPTION AND TEST OF A STRAIGHT-TUBE FLUID-DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION IN STREAMS,
For primary bibliographic entry see Field 7B.
W89-08642

WATER AND STREAMBED-MATERIAL DATA, EAGLE CREEK WATERSHED, INDI-

ANA, AUGUST 1980 AND OCTOBER AND DECEMBER 1982,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08657

WATER BUDGET AND ESTIMATED SUSPENDED-SEDIMENT INFLOW FOR REELFOOT LAKE, OBION AND LAKE COUNTIES, NORTHWESTERN TENNESSEE, MAY 1984-APRIL 1985,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08689

COMPUTER PROGRAM FOR ANALYZING CHANNEL GEOMETRY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08756

SUSPENDED SEDIMENT IN SELECTED STREAMS OF SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
D. W. Litke.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-4087, April 1983. 52p, 19 fig, 7 tab, 30 ref.

Descriptors: *Sediment yield, *Suspended sediments, *Streams, *Montana, Statistical analysis, Sediment transport, Streamflow, Sediment discharge.

Suspended sediment data collected from October 1974 through September 1979 at 44 stations in the Powder River structural basin of southeastern Montana were statistically summarized to define sediment relationships between stations and basins and to identify environmental factors that are important in determining sediment yield. Sediment transport curves were developed for 30 of these stations. Mean-annual suspended sediment discharges were determined at 15 stations using the flow duration sediment transport curve method. Sediment discharges compared within 20% at three stations where alternative calculation by daily sampling methods was possible. Mean sediment discharges ranged from 770 to 5,470,000 tons/yr and were somewhat less than yields predicted by the Langbein-Schumm precipitation-sediment-yield relation. Low delivery ratios for small drainages indicate that streams may be aggrading. Geographic variations in sediment yield are attributed to precipitation and geology. (Author's abstract)
W89-08765

SEDIMENT ACCUMULATION IN SAN LEANDRO BAY, ALAMEDA COUNTY, CALIFORNIA, DURING THE 20TH CENTURY--A PRELIMINARY REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
K. M. Nolan, and C. C. Fuller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4057, August 1986. 25p, 7 fig, 4 tab, 31 ref.

Descriptors: *Estuarine environment, *Sedimentation, *San Leandro Bay, *California, Sedimentation rates, Sediment distribution, Sediment load, Tracers, Lead radioisotopes, Cesium radioisotopes, Erosion, Radioactive dating.

Major changes made in the configuration of San Leandro Bay, Alameda County, California, during the 20th century have caused rapid sedimentation within parts of the Bay. Opening of the Oakland tidal channel and removal of 97% of the marshlands formerly surrounding the Bay have decreased tidal velocities and volumes. Marshland removal has decreased the tidal prism by about 25%. Comparison of bathymetric surveys indicates that sedimentation in the vicinity of the San Leandro Bay channel averaged 0.7 cm/annum between 1856 and 1984. Lead-210 data collected at four shallow water sites east of the San Leandro Bay channel indicated that sedimentation rates have averaged between 0.06 and 0.28 cm/annum. Because bioturbation of bottom sediments cannot be discounted, better definition of this range in sedimentation rates would required measuring the activity of lead-210 on incoming sediments. In addition to sediment deposited in the vicinity of the San Leandro Bay channel and open, shallow areas to the east, 850,740 cu m of sediment was deposited between 1948 and 1983 in an area dredged at the mouth of San Leandro Creek. All available data indicate that between 1,213,000 and 1,364,000 cu m of sediment was deposited in San Leandro Bay between 1948 and 1983. Sediment yield data from an adjacent drainage basin, when combined with inventories of lead-210 and cesium-137, indicate that most of the sediment deposited in San Leandro Bay is coming from resuspension of bottom sediments or from erosion of marshes or shorelines of San Leandro or San Francisco Bay. (Author's abstract)
W89-08802

DESIGN OF A SEDIMENT DATA-COLLECTION PROGRAM IN KANSAS AS AFFECTED BY TIME TRENDS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08824

APPLICATIONS OF GEOMORPHOLOGIC THEORY TO UNGAUGED WATERSHEDS IN SINAI,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 2E.
W89-08872

ST. HELENS BLAST RELATED SEDIMENTATION MODELING AND PLANNING REALITIES IN THE TOUTLE/COWLITZ/COLUMBIA RIVER SYSTEM,
Portland State Univ., OR. Dept. of Urban Studies and Planning.
W. A. Rabiega.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 325-331, 3 ref.

Descriptors: *Columbia River, *Sedimentation, *Volcanoes, *Floods, *Model studies, *Management planning, Stochastic process, Flood damage, Publications, Frequency analysis, Risks, Mount Saint Helen's, Washington State, River systems.

Following the Mount Saint Helen's eruption of May 18, 1980 a major planning effort was started by the United States Army Corps of Engineers to deal with potential flood and sedimentation problems related to that event. Four major reports came out of that effort with emphasis on the roles of sedimentation, frequency, and risk modeling in the planning process. New types of information concerning the assumptions of supporting models and the positive and negative consequences of selecting various management strategies were incorporated into the documents. The inherent stochastic nature of the modeling process emerged as an important issue in evaluation of recommendations from planners and engineers instead of being masked by single conclusions based on average conditions. A higher public profile for models and modelers and the attendant demands this new role implies is likely if the planning process exemplified in these documents is generally adopted. (See also W89-08863) (Author's abstract)
W89-08891

CENTRIFUGE MODELING OF RIVER BANK FAILURES DUE TO SEEPAGE FLOW,
Utsunomiya Univ. (Japan). Dept. of Civil Engineering.
O. Kusakabe, Y. Okaumura, and A. Nakase.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 399-408, 10 fig, 2 tab, 9 ref.

Descriptors: *Soil water, *Erosion, *Soil mechanics, *Centrifugation, *Model studies, *Stream banks, *Seepage control, *Bank collapse, Bank stabilization, Moisture tension, Capillarity, Groundwater, Flow velocity, Simulation analysis, Japan, Soil types, Particle size.

A series of centrifuge tests were carried out to collect data on river bank failure due to seepage flow. The following conclusions were reached: (1) Finer contents of bank material have a significant effect on the stability and failure process of river banks subjected to seepage flow. This is a strong indication that capillary tension plays an important role in the stability of unsaturated slopes. (2) Secondary failure took place for a bank made of materials having a smaller proportion of finer contents. The extent of secondary failure became smaller with an increase in finer contents. (3) Based on these model tests, an analytical model to simulate the development of the failure due to seepage flow is proposed. (Fish-PTT)
W89-08897

SEDIMENT TRANSPORT IN GRAVEL-BED RIVERS.
John Wiley & Sons, New York. 1987. 995p. Edited by C.R. Thorne, J.C. Bathurst and R.D. Hey.

Descriptors: *Geomorphology, *Sediment transport, *Rivers, *Streambeds, *River beds, *Gravel, Sediment distribution, Sediment load, Sediment-carrying capacity, Model studies, Bed load, Case studies.

Papers on sixteen topics concerning sediment transport in gravel-bed rivers are divided equally between fundamental problems and engineering case studies. Many of the case studies demonstrate the growing power of mathematical models to simulate river behavior and response to human impacts and management. Present engineering approaches tend to ignore relationships and trends identified in geomorphology, while geomorphological approaches tend to be qualitative rather than quantitative. Cooperation between scientists and engineers concerned with gravel-bed rivers presents a likely area for progress in the analysis and explanation of river processes. It was concluded that there is a need to collect sound field data for gravel-bed rivers, particularly on sediment transport rates and calibers. Although this information is difficult to obtain due to hostile physical conditions in these rivers especially during peak flows, the wide range of sediment sizes involved, and relatively low frequency and short duration of flows which transport bed sediment; the strong trend towards mathematical modelling, especially for environmental impact assessment, makes acquisition of this data vital for model development and verification. (See W89-08934 thru W89-08966) (White-Reimer-PTT)
W89-08934

DIFFERENCES BETWEEN GRAVEL AND SAND-BED RIVERS,
Simons and Associates, Inc., Fort Collins, CO.
D. B. Simons, and R. K. Simons.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 3-11, 2 fig, 1 ref.

Descriptors: *Alluvial channels, *Channel morphology, *River beds, *Streambeds, *Sediment transport, Gravel, Sand, Sandbars, Resistance, Wash load, Bank erosion, Channel erosion, Stream erosion.

River forms described in the literature, as well as the total array of bed material sizes ranging from sands to boulders, are often encountered in a single river system or basin. Some of the factors that

must be considered in studying these systems include: river form, the wide array of bed roughness, the varying magnitudes of resistance factors, the mechanics of transport of bed material for the numerous conditions encountered, the impacts of wash load on bed material for the numerous conditions encountered, the impacts of wash load on bed material transport, the mechanics of bed armouring, the characteristics and erodibility of the banks, and the impacts of varying river conditions on water resources development, navigation and the environment. It is important when managing a system to recognize that there will be a general downstream reduction in bed material size. The gravel-bed reaches of a river system will exhibit totally different morphological characteristics and, in general, they will be less responsive to modest changes in discharge and discharge duration than a sand-bed river because sand-bed material can be transported whenever flow velocities are of the order of a 0.3 meters/sec. or more. As a result, there is virtually always transport with changes in the position of bars and bed forms etc. In contrast, the steeper upland rivers respond to a lesser degree and more slowly, even though they may experience significant changes during extreme floods. Under more normal natural discharges, or even regulated flows, the mountain river is relatively stable. (See also W89-08934) (White-Reimer-PTT)
W89-08935

RIVER DYNAMICS, FLOW REGIME AND SEDIMENT TRANSPORT,
For primary bibliographic entry see Field 2E.
W89-08936

RIVER BED GRAVELS: SAMPLING AND ANALYSIS,
British Columbia Univ., Vancouver. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W89-08937

BED LOAD SAMPLING AND ANALYSIS,
Geological Survey, Lakewood, CO.
D. W. Hubbell.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 89-106, 1 tab, 8 fig, 12 ref.

Descriptors: *Bed-load samplers, *Samplers, *Sediment transport, *Bed load, *Streambeds, *River beds, *Sampling, Model studies, Sand, Gravel, Transport rate, Probability-matching, Statistical analysis, Simulation analysis, Data acquisition.

Laboratory and field measurements of sand and gravel transport demonstrate that, even at constant-flow conditions, transport rates at a point vary cyclically with time from zero (or near zero) to approximately four times the mean rate. Cumulative distributions of ordered rates obtained sequentially at a point tend to follow a common distribution function. Due to the extreme temporal variability of transport rates, bed-load-sampler calibrations developed from averages of groups of sampled and measured rates are subject to error unless the sampler has a constant sampling efficiency for all instantaneous transport rates. Laboratory calibrations by a technique called probability-matching, in which the entire distributions of sampled and measured rates are compared, show that efficiencies of all tested bed load samplers varied somewhat with transport rate and particle size. The accuracy of measurements of mean transport rate at a cross-section is also affected by the temporal variations in bed load discharge. Computer simulations, using assumed lateral distributions of mean transport rate and a simplified model of transport that is based on typical cyclic rate variations, show that repetitive sampling at each lateral position improves accuracy, and measurement effort probably can be decreased, without sacrificing accuracy, by sampling repetitively only at positions necessary for defining the lateral distribution of mean transport rates. (See also W89-08934) (Author's abstract)
W89-08938

SEDIMENT SUPPLY TO UPLAND STREAMS: INFLUENCE ON CHANNEL ADJUSTMENT,
Liverpool Univ. (England). Dept. of Geography.
A. M. Harvey.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 121-146, 1 tab, 14 fig, 26 ref.

Descriptors: *Sediment erosion, *Stable channels, *Braided streams, *Alluvial channels, *Sediment transport, *Streambeds, *River beds, *River systems, River mechanics, Aggrading rivers, Stream degradation, Stream erosion, Stream stabilization, Sediment load, Sediment discharge, Sediment distribution, Sediment erosion, Howgill Fells, England, Gully erosion.

Two types of channel system are identified in the Howgill Fells of northwest England in relation to sediment input from the hillslopes. In areas of low sediment supply, stable, single, often meandering channels occur, whose widths and gradients show a high degree of correlation with drainage area and coarse sediment caliber. In gullied catchments of high sediment input the channels are unstable and braided with much greater widths and steeper gradients. Rates of sediment supply from a gully system, cut in soliflucted glacial till, to an unstable channel were monitored. From the gullied area of c. 4000 sq meters, total sediment supply is over 150 tons per year with about one third composed of coarse sediment. Most of this supply was collected in the winter, especially for the coarse sediment. Debris cones that are built up at the base of the gullied slopes are entrained by stream floods which occur at approximately two year intervals. The coupling of the sediment supply, storage, entrainment and channel response system is adjusted to this time sequence. In 1982 a storm with a return period in excess of 100 years caused major erosion and a massive sediment input to two previously stable meandering channels. By widening, straightening and aggradation many reaches changed to a braided regime. Whether these changes persist will depend on sediment supply and flood magnitude over the next few years. Even if stabilization occurs, the boulders transported by the floods will have a long-term influence on the channel system. (See also W89-08934) (Author's abstract)
W89-08939

SEDIMENT SUPPLY, MOVEMENT AND STORAGE IN AN UNSTABLE GRAVEL-BED RIVER,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. C. Pitlick, and C. R. Thorne.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 151-178, 1 tab, 16 fig, 22 ref.

Descriptors: *Deposition, *Unstable channels, *Alluvial channels, *Sediment transport, *Sediment erosion, *Gravel, *Streambeds, *River beds, *River systems, River mechanics, Aggrading rivers, Stream degradation, Stream erosion, Flood flow, Floods, Snowmelt, Thunderstorms, Stream stabilization, Sediment distribution, Roaring River, Fall River, Colorado.

The 1982 failure of Lawn Lake dam, Rocky Mountain National Park, Colorado, resulted in greatly increased sediment loads and major channel changes in Roaring River and Fall River. Since the flood increased sediment transport rates and morphological changes have been documented during snowmelt and thunderstorm generated flows. In 1983 record snowmelt discharges produced high sediment loads in Roaring River. This sediment was transported about 3 km downstream to an undisturbed, highly sinuous reach and deposited in a storage zone that was approximately 2000 meters long. Within the storage zone the channel aggraded approximately 0.75 meters to the level of the flood plain. Sediment transport below this depositional zone was low in 1983. In 1984 snowmelt discharges were lower and sediment delivery from Roaring River decreased, but transport in Fall River was maintained. As a result, the upper end of the storage zone was eroded to the preflood bed. However, thunderstorm flow events contrasted sharply with renewed erosive activity in the Roaring River valley, again contributing high loads to Fall River, but only for short durations. These observations indicate that high snowmelt and thunderstorm discharges are effective in supplying sediment to channels which moderate discharges are then able to move. As a result, sediment transport is very unsteady and non-uniform, and channel response is complex. (See also W89-08934) (Author's abstract)
W89-08940

TRANSPORT PROCESSES AT THE CATCHMENT SCALE,
Institute of Hydrology, Powys (Wales). Fluvial Geomorphology Unit.
M. D. Newson, and G. J. Leeks.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 187-218, 3 tab, 14 fig, 62 ref.

Descriptors: *Bank erosion, *Watershed management, *Sediment transport, *Streambeds, *River beds, *River systems, *Geohydrology, Catchment Areas, Wales, River mechanics, Stream degradation, Stream erosion, Stream stabilization, Sediment distribution, Sediment erosion, Data acquisition, Management planning, River Trannon.

A five-year study of the major rivers of mid-Wales, centered on the Plynlimon upland using bed and suspended sediment monitoring, sediment tagging by the magnetic method, ground survey, sedimentological/hydraulic survey and historical analysis through maps is described. The majority of the suspended sediment samples analyzed were found to be similar to alluvial bank-face material. This finding adds support to the thesis that bank erosion may be the major factor in suspended load yields in Mid-Wales. A protection scheme on the River Trannon involving the dredging of a trapezoidal channel and construction of low flood embankments was started in 1978. However, this scheme has permitted enhanced erosion and disruption of channel sediments which has led to an increased availability of sediment for transport. This may cause further instability in downstream reaches resulting in high cost for channel maintenance. A number of recent studies have discussed the extent of managed and maintained channels in England and Wales and suggested more enlightened approaches to design, construction and maintenance. In addition to encouraging river engineers to be aware of upstream geomorphology in addition to reach hydraulics, land managers of upland catchments must be made aware of the downstream implications of their actions. The advantages of the regional approach have yet to be fully realized by data processing of the mid-Wales results, but it is clear that fuller quantification of input, output, transport and storage rates is possible and leads both to essential monitoring of change and to a better appreciation of time-related phenomena in sediment systems. (See also W89-08934) (White-Reimer-PTT)
W89-08941

SEDIMENT BALANCE CONSIDERATIONS LINKING LONG-TERM TRANSPORT AND CHANNEL PROCESSES,
Northwest Hydraulic Consultants Ltd., Edmonton (Alberta).
C. R. Neill.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 225-240, 9 fig, 25 ref.

Descriptors: *Erosion, *Sedimentation, *Channel morphology, *Dam effects, *Sediment transport, *Streambeds, *River beds, *River systems, Geohydrology, River mechanics, Stream degradation, Stream erosion, Stream stabilization, Sediment yield, Sediment distribution, Sediment erosion, Meanders, Sandbars.

Specific principles and quantitative relationships applicable to selected idealized cases including down-valley migration of meanders, channel cross-section changes associated with bar formation and decay, and channel degradation below dams including the effect of armouring are formulated. In

the case of systematic meander migration, sediment-balance relationships may be used to estimate long-term transport from known morphological behavior, to estimate the limits of local channel shift from known sediment transport, or to estimate the effects of an altered sediment transport regime on morphological changes. In the case of channel degradation below dams, sediment-balance considerations lead to interesting conclusions about the effect of armouring and the practicability of controlling degradation. These approaches can sometimes provide an independent check on sediment transport measurements and day-by-day modelling based on sediment transport equations. The application of sediment-balance relationships should not be carried too far without attempts at verification. An understanding of the local geomorphic-hydraulic regime based on geological interpretation and field inspection is essential. Insufficient attention to local peculiarities can lead to inappropriate solutions; for example, the siting of a sediment trap dam upstream of the principal source of sediment. (See also W89-08934) (Author's abstract)
W89-08942

STATIC ARMOUR LAYERS BY SELECTIVE EROSION,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
A. J. Sutherland.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 243-260, 1 tab, 6 fig, 19 ref.

Descriptors: *Sediment sorting, *Armoring, *Sediment transport, *Sediment erosion, *Channel erosion, *Stream erosion, *Alluvial channels, Geohydrology, Armor layers, Shear stress, Threshold stress, Data interpretation.

Selective erosion in an alluvial channel reach for which there is no upstream sediment input can lead to the formation of a static armor layer. This layer is at rest, is coarser than the underlying material and inhibits sediment transport from the reach. A review of the work on the formation of static armor layers to determine what conditions and mechanisms cause their formation, and to study their properties and predictability was conducted. Little progress has been made in quantitatively defining the necessary conditions for armoring. However, the interplay between the distribution of applied shear stresses and that of the threshold stresses associated with particles in the surface layer is of major importance. The concepts of sheltering and the formation of discrete armouring units which act to protect the sublayer can be used in laboratory observations for qualitative descriptions of the armoring mechanisms. Prediction methods for static armor layer composition all agree that the layer coarsens (median size increases) during the selective erosion process. Prediction of the composition of armor layers can be done for laboratory situations in which the original material is often log-normally distributed and the flow conditions are well defined. Shen and Lu's method is the recommended single-step method while that of Ashida and Michuie is the preferred multistep method. Field data suitable for testing the proposed methods are sparse. Some data sets, including some used in this study, do not refer to static armors. There may be sediment supply from upstream causing either a mobile armor or an overpassing situation. (See also W89-08934) (White-Reimer-PTT)
W89-08943

FORMATION OF A COARSE SURFACE LAYER AS THE RESPONSE TO GRAVEL MOBILITY,
Geological Survey, Denver, CO.
E. D. Andrews, and G. Parker.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 269-300, 13 fig, 37 ref. U.S.E.P.A. Grant No. R-808683, NSF Grant No. CEE-8311721.

Descriptors: *Sediment sorting, *Alluvial channels, *Sediment transport, *Streambeds, *River beds, *Fluvial sediments, *Gravel, Bed load, Bedload discharge, Flow, Particle size, Particle shape, Systems analysis.

The concept of hiding is used to discuss the relative mobility of particles of various sizes in poorly sorted fluvial gravel. An analysis of bed load transport in gravel streams indicates that most available sizes are transported by flow equal to or greater than the mean annual flood. The size distribution of the bed load is similar to that of the subsurface material, which characterizes the bulk of the sediment stored in a river reach. However, the material on the surface of a gravel-bed stream is typically much coarser than either the bed load or the subsurface material. This coarse surface layer, or pavement, is present even while most available sizes are transported, and is the agent for accomplishing a near-equalization of the mobility of particles based on the size distribution of subsurface material. In particular, the relatively greater exposure of large surface particles to the flow eliminates most, but not all, of the differences in mobility between particles of differing sizes. Much of the remaining difference is eliminated by the relative abundance of the coarse particles in the surface compared to the small particles. Therefore, the intrinsically lower mobility of the coarse surface particles is counterbalanced by their greater availability to the flow. Laboratory and field data support this hypothesis. As the bed load transport rate approaches zero, the pavement devolves into an even coarser static armor. (See also W89-08934) (Author's abstract)
W89-08944

CANAL DESIGN BY AN ARMOURING PROCESS,
Shaw Mont Newfoundland Ltd., St. John's.
For primary bibliographic entry see Field 8A.
W89-08945

RIVER BED SCOUR AND CONSTRUCTION OF STONE RIPRAP PROTECTION,
Northwest Hydraulic Consultants Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 8D.
W89-08946

CONCEPTUAL MODELS OF SEDIMENT TRANSPORT IN STREAMS,
Oregon State Univ., Corvallis.
R. L. Beschta.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 387-408, 9 fig, 47 ref.

Descriptors: *Sediment transport, *Model studies, *Streambeds, *River beds, *Channel flow, *Sediment load, *Bed load, Stream degradation, Stream erosion, Channel erosion, Mathematical models, Suspended load, Suspended sediments.

The movement of sediment in stream systems is influenced by a wide range of factors including variable source areas of sediment, transient flows, variable particle sizes, nonuniformity of channel geometry and flow, and dynamic/adjusting channels. Variations of suspended sediment concentration are often illustrated in the hysteresis of sediment rating curves, seasonal flushing, and effects related to time rate changes in flow and other patterns. A supply-based model is described which is able to reproduce the sediment concentration dynamics of complex storm hydrographs. This suspended load transport model attempts to account for variations in sediment supply and incorporates concepts of non-uniformity in sediment supply, particle size and in stream hydraulics. Although suspended load and bed load are characteristically identified as the two major modes of sediment transport in stream systems, these delineations become indistinct for particles in the range of approximately 0.1-1 mm in diameter. Bed load transport has high temporal and spatial variability, making accurate prediction difficult with hydraulically-based bed load formulae. Part of this variability may be associated with local aggradation and degradation of the bed during high flow events. (See also W89-08934) (Author's abstract)
W89-08947

INVESTIGATION OF SEDIMENT ROUTING BY SIZE FRACTIONS IN A GRAVEL-BED RIVER,
Simons, Li and Associates, Inc., Fort Collins, CO.
R. Li, and W. T. Fullerton.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 421-442, 2 tab, 7 fig, 11 ref.

Descriptors: *Sediment sorting, *Particle size, *River beds, *Sediment transport, *Gravel, *Model studies, *Sediment load, *Bed load, Stream degradation, Stream erosion, Channel erosion. Computer models, Suspended load, Suspended sediments, Armoring, Salt River, Arizona.

Four different versions of the sediment routing model QUASED were executed for the 100-year flood for a portion of the channelization project in the Salt River, near Phoenix, Arizona. The four versions had different variations of the transport equations and of the formulations for the armoring and detachment process. There were significant differences between the amounts of aggradation and degradation predicted by each version of the model. The selection and calibration of a sediment transport equation appropriate to the conditions is important because the hydraulic conditions can often be outside the range for which the transport equations were initially verified. Calibration of transport relationships is difficult in rivers like the Salt River because of their ephemeral nature and the resulting lack of measured sediment transport rates. Calibration can usually be accomplished only by matching past historical responses. To model the bed response of a gravel-bed and cobble-bed stream, the armoring process must be simulated by routing of the sediments by size fraction. Limitations on the depth of detachment can also be incorporated to further restrict the depth to which the flow may detach sediments before an armor layer is formed. Therefore, the program must include a test to determine when an armour layer exists. The criterion used was a layer of sediment sizes equal to or larger than the critical diameter for incipient motion and at least twice the critical diameter in thickness. A wide range of answers can result when applying sediment routing models with equally appropriate models producing quite different results. Therefore, when using sediment routing models, all available information must be used to help identify the accurate responses. (See also W89-08934) (White-Reimer-PTT)
W89-08948

BED LOAD DISCHARGE EQUATION FOR STEEP MOUNTAIN RIVERS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
J. C. Bathurst, W. H. Graf, and H. H. Cao.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 453-477, 5 tab, 8 fig, 55 ref.

Descriptors: *Stream gradient, *Sediment transport, *Bed load, *Sediment discharge, *Sediment load, River flow, Streamflow, Mountain streams, Mathematical equations, Schoklitsch equation, Flumes, Data acquisition, Data interpretation, Field tests.

The data collected in steep flumes and rivers have been used to identify existing bed load discharge equations which are appropriate to mountain rivers with coarse sediment. The flume data consist of measurements of flow parameters, sediment discharge and bed form development for flows over three different sediment beds (D sub 50 = 11.5, 22.2, and 44.3 mm) at a variety of slopes (S = 0.5 to 9 percent) and unit water discharges (q = 0.017 to 0.417 sq meters/sec). Combined with other flume and field data these data show that initiation of bed load transport can be predicted by the Schoklitsch approach (based on critical water discharge), modified to allow for the effect of nonuniform sediment size distribution. Investigation shows that the Schoklitsch equation provides the most accurate predictions for the flume data. This is partly because it does not explicitly involve depth, a variable which is difficult to measure accurately in steep, rough flows. Tested against

river data this equation applies with order of magnitude accuracy where sediment availability is unlimited (typically in channels with slopes equal to or less than one per cent). However, it significantly over-predicts sediment discharge in the smaller mountain rivers where sediment availability is determined by sediment size distribution and external supply effects. (See also W89-08934) (Author's abstract)
W89-08949

FIELD MEASUREMENTS IN A GRAVEL-BED RIVER WHICH CONFIRM THE THEORY OF WHITE ET AL.,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
S. M. Thompson.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 493-505, 3 tab, 6 fig, 12 ref.

Descriptors: *Channel accretion, *River mechanics, *Sediment transport, *River beds, *Streambeds, *Channels, *Channel erosion, *Channel morphology, Stream degradation, Gravel, White, Bettess and Paris theory, Ohau River, New Zealand, Mathematical analysis, Channel scour.

Field measurements of channel geometry, water velocity and bed load in the Ohau River were made in order to test the theory of White, Bettess and Paris, which predicts the hydraulic regime in flooding rivers. Channels formed by flows of up to 500 cu meters/ sec in gravel with a median particle size of D = 0.02 meters, on a flood plain slope of 0.006 were measured. The bed load in the river was estimated from measurement of delta accretion. The results are not inconsistent with the theory, but are not extensive enough to be conclusive. As the bed or banks of a branch channel erode or accrete, the channel shape develops towards that predicted by the theory but various factors limit its spatial extent and temporal persistence, such as: (1) reduced inflow of water as the river flow declined or another branch captures the flow; (2) increased inflow of sediment carried by relatively small transverse inflows of water down the steep sides of the channel; and (3) reduced outflow of sediment either because the downstream water level rises or because of an obstruction in the channel. These factors cause aggradation and reduction of widening. The channels conforming to the theory are the deepest and occupy the lowest points on the bed. The deep channels, in which flow lines are parallel, are very much more extensive and almost as deep as the scour holes caused by flow lines which converge. Eventually, the river scours and transports bed material down to the depth of the deeper channels over the whole of the active bed. Thus, the theory is applicable to all parts of the river bed although at any particular time during a flood, only a small part of the bed is occupied by flows in branch channels with the theoretical proportions. (See also W89-08934) (White-Reimer-PTT)
W89-08950

MOUNTAIN TORRENT EROSION,
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
K. Ashida.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 513-537, 18 fig, 17 ref.

Descriptors: *Alpine regions, *Sediment transport, *Erosion, *Channel erosion, *River beds, *Streambeds, *Stream erosion, Shear stress, Mathematical analysis, Bank erosion, Bank stabilization, Erosion control, Dams, Sabo dams, Slope degradation, Bed load.

By using mass and momentum equations, the calculation of the critical slopes for the initiation and cessation of motion and the calculation of the transport velocity as well as the runout distance of the soil block, the dynamic behavior of a soil block released by a slope failure can be addressed. When there is enough water to fill the increased void space and the channel slope is steep enough to provide the propelling force, a soil block will be crushed into grains by the gravity-induced shearing force during its movement and will become transformed into a debris flow. A debris flow is characterized by sediment particles dispersed in water or a clay slurry at a concentration slightly lower than that needed for stable sediment accumulation. It often moves at a surprisingly high speed and travels some hundreds of meters over comparatively gentle slopes, transporting a great number of huge boulders. The sediment transport rate will increase longitudinally as the percentage of particles detached from the bed surface increases with distance downstream. When the shear stress on a side bank exceeds the critical shear stress, the bank erodes. The three types of erosion control systems are: hillside works, such as restoration of vegetation and terracing; ground sill or a sabo dam constructed on a gully or a channel for controlling erosion or checking sediment yield; and channel works constructed along the river course on an alluvial fan where a considerable amount of sediment is produced. (See also W89-08934) (White-Reimer-PTT)
W89-08951

SEDIMENT TRANSPORT IN STEP-POOL STREAMS,
Ministry of Works and Development, Lower Hutt (New Zealand). Central Labs.
J. G. Whittaker.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 545-570, 20 fig, 40 ref.

Descriptors: *Ponded streams, *Channel morphology, *Sediment transport, *Streamflow, *Streambeds, Weirs, Model studies, Scour, Field tests, Mountain streams, Step-pool streams, Sediment distribution, Sediment load, Catchment areas.

The steps and pools found in mountain streams are formed by large flood events and are extremely stable under normal flow conditions. Sediment transport in step-pool streams is usually supply-limited with sediment typically derived from a few limited sites within the stream's catchment and often entering as a bulk input. These bulk inputs tend to be transported as long low waves through the channel, and stored within the channel as movement of the wave ceases with low flow rates. Therefore, sediment transport rates measured at a particular location on the stream vary greatly with time and flow rates. Tests with a succession of weirs were performed in order to obtain information on the process of scour between the steps, with and without sediment transport, and on the mechanics of sediment transport through an idealized step-pool system. In the sediment transport test instabilities in the sediment transport rate and the flow occurred in some cases despite a steady sediment input rate and a constant flow input. This finding suggests that a long low wave of sediment moving through a step-pool system will itself be moved as a series of smaller waves. Results from the tests were used as the basis for modeling the transport resulting from bulk or unsteady inputs of material to the channel. Realistic long waves similar to those observed in prototype streams were predicted by the model. Therefore, sediment transport in step-pool streams can be predicted from a knowledge of the mechanics of the scour of pools between steps. (See also W89-08934) (White-Reimer-PTT)
W89-08952

BED LOAD TRANSPORT MEASUREMENTS BY THE VORTEX-TUBE TRAP ON VIRGINIO CREEK, ITALY,
Florence Univ. (Italy). Dept. of Civil Engineering.
P. Tacconi, and P. Billi.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 583-606, 2 tab, 16 fig, 14 ref.

Descriptors: *Sediment transport, *Stream erosion, *Sediment samplers, *Samplers, *Flood flow, *Italy, *Bed load, River mechanics, Hydrologic properties, Virginio Creek, Pesciola Creek, Sediment yield, Flood discharge, Correlation analysis, Particle size.

The hydrological aspects, erosion phenomena, sediment yield, bedload transport and fluvial dynamics for Virginio and Pesciola Creek have been studied since 1975. Bed loads can be measured at flows up to 10 cu meters/sec using a flume and vortex-tube trap. The continuous recording data indicate a pulsating bed load transport process. It is believed that this pattern occurs because of an interaction process between the bed load particles and the bed. It is possible the amount of entrained bed material increases progressively until it reaches a maximum and exhausts the supply. A correlation analysis was performed to determine possible relationships between the measured parameters for the flood events. No significant correlations were found probably because of the variability of the measured parameters. It was observed that the grain size characteristics of bed load sediment remained approximately the same in time and were independent of the variations that occurred in the flow and sediment transport rates. Theoretically, the grain size distribution of the sediment in motion should vary with the flow; however, this assumption has never been verified by the data measured with the vortex-tube trap. (See also W89-08934) (White-Reimer-PTT)
W89-08953

BED LOAD TRANSPORT IN DESERT FLOODS: OBSERVATION IN THE NEGEV,
Hebrew Univ. of Jerusalem (Israel). Dept. of Physical Geography.
A. P. Schick, J. Lekach, and M. A. Hassan.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 617-636, 4 tab, 7 fig, 25 ref.

Descriptors: *Deserts, *Flash floods, *Sediment transport, *Flood flow, *Bed load, *Streamflow, *Streambeds, *River flow, *River beds, Israel, Field tests, Catchment areas, Scour, Alluvial deposits, Tracers, Data interpretation, Sediment load, Nahal Yael, Negev.

Coarse bed load provides one-half or more of the long-term sediment yield of Nahal Yael. Pebbles and cobbles are transported, in significant events, over distances of 15-100 meters per event with little dependence on size and a large variation between individual particles. Fortuitous sampling of total sediment load in an upland tributary of Nahal Yael during a 4 hour long event enabled an analysis which suggests that bed load transport in channels devoid of alluvial cover occurs in pulses unrelated to water discharge characteristics, but may reflect and intrinsic feature of catchment dynamics. The regular spacing of pools and riffles and of gravel bars in alluvial reaches further downstream may therefore be initiated from upstream. Detailed three-dimensional analysis of the bed load as deposited in the Nahal Yael reservoir by two flood events indicated deposition by a pulsating mechanism, with pebbly material overlying finer grained deposits. A tracing program indicated that particles that travel the greatest distance appear to have been buried at one time or another during their downstream journey. A drawback of the tracing method is the inability to locate particles completely embedded in the scour layer. A new method based on magnetic labeling made detection to a depth of 60 cm possible. This method resulted in a significant increase of the recovery rate from about 50% to 95% per flood event. (See also W89-08934) (Author's abstract)
W89-08954

INFLUENCE OF LARGE SUSPENDED-SEDIMENT CONCENTRATIONS IN RIVERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. B. Bradley, and S. C. McCutcheon.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 645-675, 3 tab, 11 fig, 62 ref.

Descriptors: *Suspended sediments, *Sediment concentration, *Rivers, *Mudflows, *Sediment transport, *Streambeds, *River beds, *Stream erosion, Mount St. Helens, Sediment erosion, Sediment distribution, Sediment load, Sediment-carry-

ing capacity, Turbulent flow, Buoyancy, Viscosity, Velocity, Bed load.

Sediment concentrations ranging from a few milligrams per liter up to 60-70 per cent by volume were observed in Mount St. Helen's flows. A universal system of classifying sediment-bearing flows does not exist because the relative importance of turbulence, buoyancy, viscosity, dispersive pressure or structural support, and cohesion is not fully understood for the full range of concentrations of all types of sediment. Some fluid-sediment properties like density are easily computed while other properties like viscosity and fall velocity are not fully understood. Fall velocity is related to viscosity and also depends on sediment type. The fall velocity of sands in similar concentrations of bentonite, kaolinite and silt wash loads has been observed to vary at least two orders of magnitude. Limited experimental investigation into the complex interaction of viscous, turbulent, dispersive and cohesive forces limits the present ability to predict fall velocity, and subsequently sediment transport at larger concentrations. It is presently impossible to accurately predict vertical velocity and sediment profiles, frictional resistance and sediment transport across the full spectrum of large concentration flows. Variation in bed form and plan form also results from large concentration flows. Bed form and channel roughness have been observed to affect flow depth by 3 ft in the Cowlitz River, near Mount St. Helens. Calculation of suspended loads and any effect on bed loads remains quite uncertain. Equations such as those of Einstein, Meyer-Peter and Muller, and Colby may be used with varying success for concentrations less than 20 per cent by volume. The inability to predict erosion and deposition of mud and debris flows results in uncertain estimates of sediment transport for these flow ranges. (See also W89-08934) (White-Reimer-PTT)
W89-08955

SUSPENDED LOAD IN GRAVEL-BED RIVERS: UK EXPERIENCE,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling, and B. W. Webb.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 691-723, 8 tab, 11 fig, 54 ref.

Descriptors: *Suspended load, *Gravel, *River beds, *Sediment transport, *Sediment distribution, *Streamflow, *River flow, *England, Sediment yield, Field tests, Data processing, Flow pattern, Particle size, Nutrients, Nitrogen, Phosphorus, Carbon, River Exe.

Annual sediment yields in UK rivers are low by world standards and range form less than 1 to nearly 500 tons/sq km per year. Suspended sediment concentrations are also relatively low, rarely exceeding 5000 mg/l and often not rising above 500 mg/l. Results of a seventeen-year investigation of the River Exe using manual and continuous recording meters indicate that suspended-sediment concentration dynamics are characterized by seasonal and storm-period hysteresis, and that sediment transport is more strongly influenced by sediment availability than by transport energy. Detailed sediment data have stressed the importance of time-variant sediment supply and have also been used to show that traditional procedures for calculating sediment transport, based on the construction of rating curves from infrequent samples, may produce estimates lacking in both accuracy and precision. Problems of estimating sediment yield reflect the bias of transport towards episodic high flows with magnitude and frequency analyses indicating that 50 per cent of the suspended-sediment load is removed in only 0.2 per cent of the study period at some sites. More recent studies in the Exe Basin assessing quality as well as quantity suggest that particle aggregation may be a common feature in fluvial environments. Studying the carbon, nitrogen and total phosphorus content of suspended sediment has revealed that sediment-associated transport makes a significant contribution to nutrient loads. Furthermore, data covering a range of sediment properties have proved useful in evaluating the relative importance of different sediment sources in this catchment. (See also W89-08934) (Author's abstract)
W89-08956

ENERGY DISSIPATION RATE APPROACH IN RIVER MECHANICS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 735-758, 3 tab, 6 fig, 45 ref.

Descriptors: *Sediment transport, *Channel morphology, *Stream profiles, *River mechanics, *Energy dissipation, *Alluvial channels, Energy gradient, Sediment discharge, Streambeds, River beds, Sand, Gravel, Friction, Friction loss, Sediment concentration, Stream power, Alluvial rivers.

A review and evaluation of theories and hypotheses used in the study of sediment transport and its effect on the adjustment of channel geometry, profile, pattern and roughness led to the following conclusions: (1) Among all the assumptions used in the study of sediment transport, the assumption that rate of sediment transport should be related to the rate of energy dissipation in transporting sediment is most general and consistent. (2) It can be shown both theoretically and experimentally that sediment concentration is directly related to unit stream power, and equations derived from the unit stream power concept can be applied to sand and gravel transport. (3) The theory of minimum energy and energy dissipation rate can be applied to a closed and dissipative system with or without sediment transport. The theories of minimum stream power and minimum unit stream power are special and simplified versions of the theory of minimum rate of energy dissipation. These theories can be applied to the study of the dynamic adjustment of alluvial channels with sand and gravel beds. (4) The hypotheses of maximum sediment discharge and maximum friction factor describe certain phenomena observed in an alluvial system and are limited to those conditions where sediment discharge or friction factor can be treated as a variable and can be maximized. (5) Minimization of stream power and maximization of sediment discharge can reach the same solution wherever the latter can be maximized. The friction factor of an alluvial system may increase or decrease. However, the rate of energy dissipation is always being minimized during the process of reaching a dynamic equilibrium condition. (See also W89-08934) (White-Reimer-PTT)
W89-08957

EXTREMAL HYPOTHESES APPLIED TO RIVER REGIME,
Hydraulics Research Ltd., Wallingford (England).
R. Bettess, and W. R. White.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 767-778, 3 fig, 21 ref. Dept. of the Environment (UK) under Contract PECD 7/6/29-204/83.

Descriptors: *Sediment transport, *Channel morphology, *Stream profiles, *Regime streams, *Alluvial channels, *River mechanics, Mathematical studies, Mathematical equations, Energy dissipation, Energy gradient, Friction, Data analysis, Stream power, Sediment concentration.

Regime theories are used to predict the shape of stable alluvial channels. Frequently an extremal hypothesis, such as minimum stream power or maximum sediment concentration, is invoked to enable the complete system to be determined. However, an arbitrary selection of sediment and friction relationships combined with an extremal hypothesis may not provide a satisfactory regime theory. The results using the Ackers and White sediment and friction relationships indicate that although the principles of minimum stream power and minimum unit stream power give differing results for width, the differences for a practical range of parameters are such that one is not preferable to the other. The predictions of regime slope are virtually identical for the parameter range considered. The results show that for practical purposes minimum energy dissipation is effectively indistinguishable from minimum stream power. The work of Griffiths indicates the care that is required in formulating equations. The apparently minor adjustment of replacing the hydraulic radius by the depth in the various equations has a major impact upon the results as it radically affects the dependence of the equations on the width of the channel. (See also W89-08934) (White-Reimer-PTT)
W89-08958

PROBLEMS OF BED LOAD TRANSPORT IN BRAIDED GRAVEL-BED RIVERS,
Lincoln Coll., Canterbury (New Zealand). Dept. of Agricultural Engineering.
T. R. H. Davies.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 793-811, 3 fig, 36 ref.

Descriptors: *Sediment transport, *Streambeds, *River beds, *Streamflow, *Braided streams, *Alluvial channels, *Bed load, *Gravel, Sediment load, Gravel, Data processing, Model studies, Field tests, Hydrologic properties, Mathematical analysis, New Zealand, Prediction, Rivers, River flow.

In order to evaluate the response and minimize detrimental repercussions in braided gravel-bed rivers, bed load and morphological changes due to engineering or other development must be predictable. However, there are major problems associated with the measurement and prediction of bed load transport rate and river morphology due to the variability of the system. Previous studies based on point measurements, sediment budgets and stochastic data input to a bed load equation indicate massive variability in the hydraulic characteristics of braided rivers with few clear trends. Conventional bed load prediction methods fail due to the huge quantity of field data needed to describe the distribution of depths, slopes, velocities and sediments in a braided river. Bed load may correlate in black-box fashion with total stream power, but hydraulic variability is likely to influence this correlation. Stochastic input data generation needs a large body of field data to establish the statistical data parameters with characteristic scale modelling apparently the only possible way to acquire realistic bed load data. Quantification of river behavior may be achieved using data on channel, or bar, pattern evolution from digital image analysis. This readily recorded braided river parameter may be a useful surrogate for morphological variation, and may be used to calibrate a black-box bed load predictor if model bed load data and channel patterns are shown to be realistic. (See also W89-08934) (Author's abstract)
W89-08959

INTERACTION OF BED LOAD TRANSPORT WITH BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
M. N. R. Jaeggi.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 829-841, 7 fig, 28 ref.

Descriptors: *Sediment transport, *Streambeds, *River beds, *Channel morphology, *Alluvial channels, Sandbars, Bar migration, Bed load, Sediment load, Gravel, Model studies, Hydrologic properties, Mathematical analysis, Thalweg, Streamflow, River flow.

In gravel-bed rivers the bed material moves only as bed load. From laboratory experiments it is generally accepted that the material which is transported as bed load constitutes a layer which is one grain size thick. In prototype rivers the transport mechanism may be similar to that in narrow channels which possess plane beds. However, many of these channels exhibit the well known feature of alternate bars. In such rivers there is a strong interaction between bar migration and bed load transport. Since a similar interaction exists in natural braided or meandering channels, the effect of alternate bar formation on bed load transport can

be taken to be a model of the more general process. Criteria for predicting alternate bar formation have been developed which are functions of channel geometry, flow parameters and bed material characteristics. Bar migration rates and bar height are correlated to at least part of the bed load transport rate. Bar height is basically a function of channel width and grain size. Bar migration rate is a parameter which can easily be detected in the prototype. Part of the bed load moves along the channel thalweg without affecting bar migration. However, only the part involved in bar migration should be seen as an indicator of river bed changes. Since bars are also sediment storage areas, and bar height influences bed load transport velocity, bar formation may slow down river bed evolution. This factor may have to be considered in the numerical modeling of rivers. (See also W89-08934) (Author's abstract)
W89-08960

RESERVOIR SEDIMENTATION AND INFLUENCE OF FLUSHING,
P. Ackers, and G. Thompson.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 845-861, 5 fig, 13 ref.

Descriptors: *Flushing, *Silting, *Sedimentation, *Reservoirs, *Reservoir silting, Sluices, Reservoir capacity, Model studies, Reservoir design, Reservoir operation, Reservoir storage, Economic aspects, Flooding, Intakes, Turbines, Dam effects, Electric power production.

The practical problems arising from reservoir sedimentation include: (a) loss of storage and consequently loss of yield; (b) increased upstream flooding; (c) blockage of intakes; (d) abrasion of turbines; and (e) impact on downstream river regime. Techniques available for assessing the sedimentation in reservoirs such as observations based on hydrological data and reservoir survey provide both direct monitoring information, and calibration and validation data for computational models. These models can then be used to forecast the future life of reservoirs. The impact of sedimentation depends to a large degree on the ratio of reservoir volume to mean annual inflow and it is in small-ratio reservoirs that particular attention has to be given to sluicing if a reasonable life is to be achieved for the storage. Sediment sluicing by the use of capacious bottom outlets can effectively extend the life of reservoirs. However, sluicing involves operational procedures that may limit both the amount of water available and when it is available. The greatest efficiency of sluicing occurs with the reservoir drawn well down, and this could easily prevent power generation for one or two months of the year. It also requires bottom outlets large enough to discharge flows well in excess of the mean annual discharge with the reservoir drawn down. These factors have a major influence on scheme economics and an important function of the sedimentation simulations is to interact with the overall economic studies of the project in order to find the most beneficial compromise between conflicting requirements. Flexibility of operation should be designed into the project by generous provision of outlets at a low level. (See also W89-08934) (White-Reimer-PTT)
W89-08961

DESIGN PROBLEMS IN GRAVEL-BED RIVERS, ALASKA,
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 8A.
W89-08962

TIME-VARYING STOCHASTIC MODEL OF THE FREQUENCY AND MAGNITUDE OF BED LOAD TRANSPORT EVENTS IN TWO SMALL TROUT STREAMS,
Freshwater Biological Association, Ambleside (England).
P. A. Carling, and M. A. Hurley.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 897-917, 4 tab, 7 fig, 26 ref.

Descriptors: *Model studies, *Model studies, *Bed load, *Alluvial channels, *Sediment transport, *Streambeds, *Streamflow, River flow, Streamflow forecasting, England, Mathematical models, Stream degradation, Stream erosion, Regression analysis, Scouring, Trout streams, Bed load discharge, Gravel, Invertebrates, Trout, Runoff, River beds.

In gravel-bed streams in the Pennine uplands of England most bed load movement occurs episodically during short discrete runoff events. A two-part model has been fitted to the frequency and magnitude of bed load mass-transport events using a time-varying Poisson process fitted to event timings, with the Poisson rate varying continuously in a seasonal pattern superimposed upon an overall decline symptomatic of short-term climatic change. Event magnitude is then described by a regression model containing stream peak discharge and an autoregressive moving average error structure. The two-part model was initially fitted to data from one stream and its general applicability tested by fitting it to data from the second stream. With some minor reservations, the model fit the data from both streams quite well. There were more flood events responsible for bed load transport then was anticipated. However, some events merely winnow fine sediment from the surface layer of coarse gravel while a few larger events result in the disruption of the coarser gravels. It should be possible to calculate the probability of winnowing events or scouring events of a certain magnitude occurring at any given time in relation to channel stability criteria or invertebrate/salmonid ecology. The variability between years in event frequency was not reflected in load throughput in either stream. This demonstrates that: (a) bed load transport is largely an undercapacity load; and (b) the streams are in a state of dynamic equilibrium which, over short time spans, may be viewed at present as being close to steady state conditions. (See also W89-08934) (White-Reimer-PTT)
W89-08963

CASE STUDY OF MINIMUM STREAMFLOW FOR FISHERY HABITAT IN THE YAMPA RIVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. S. O'Brian.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 921-942, 1 tab, 11 fig, 21 ref.

Descriptors: *Minimum flow, *Aquatic habitats, *Instream requirements, *Fisheries, *Sediment transport, *Streamflow, *River flow, *Stream fisheries, Substrates, Streamflow forecasting, Hydrographs, Model studies, Colorado squawfish, Fish spawning, Cobbles, Field tests, Structural models, Mathematical models, Simulation analysis, Colorado, Case studies, Yampa River.

The minimum streamflow for fishery habitat maintenance in the Yampa Canyon encompasses a range of discharges which will transport the bulk of the total annual sediment load, inundate the active channel area, maintain the existing substrate characteristics and sustain the dynamic processes associated with the biological demands of the system. The minimum streamflow hydrograph for the river was designed from the results of a two-year field data collection program, a physical model, laboratory simulation of flows on a cobble substrate and a mathematical model simulation of sediment transport. The minimum streamflow criteria focused on ensuring a relatively sand-free cobble substrate during the summer months where the Colorado squawfish were observed to spawn. A peak discharge of 11,500 cu ft/sec (the effective discharge and one-half the bankfull discharge) and a gradual recessional limb were modeled to remove the sand from the cobble interstices for the 1983 sediment supply. The modeled condition, which was observed in the field, was a sand level of one-half the diameter below the cobble surface during the period of Colorado squawfish spawning. From the flume investigation it was learned that sand could be scoured to a depth approximately one median cobble diameter below the cobble surface without cobble mobilization. (See also W89-08934) (White-Reimer-PTT)
W89-08964

ESTIMATING THE TRANSPORT AND DEPOSITION OF MINING WASTE AT OK TEDI,
Ok Tedi Mining Ltd., Port Moresby (Papua New Guinea).
For primary bibliographic entry see Field 5B.
W89-08965

MODELLING FLUVIAL PROCESSES IN STREAMS WITH GRAVEL MINING,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W89-08966

SEDIMENT-TRANSPORT CURVES,
Geological Survey, Reston, VA. Water Resources Div.
G. D. Glysson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-218, 1987, 47p, 25 fig, 7 tab, 13 ref.

Descriptors: *Sediment transport, *Mathematical analysis, *Graphical analysis, Regression analysis, Mathematical studies, Computer models.

The process of developing a sediment transport curve is discussed with respect to the choice of dependent and independent variables, procedures for developing a transport curve, and the effects that seasons, major sediment transporting events, and timing of peaks can have on the shape of sediment transport curves. Examples of the visual fit, linear regression, and group average methods are given. Problems associated with computer generated transport curves and potential errors are also discussed. If computer programs are used to fit the sediment-transport curves to the data points, these curves should be check for their reasonableness and consistency over the full range of water discharges for which they will be used. The best curve to use is the simplest one that still defines the relation between sediment and water discharge. (Lantz-PTT)
W89-08989

SEDIMENT TRANSPORT CHARACTERISTICS OF SELECTED STREAMS IN THE SUSITNA RIVER BASIN, ALASKA: DATA FOR WATER YEAR 1985 AND TRENDS IN BEDLOAD DISCHARGE, 1981-85,
Geological Survey, Anchorage, AK. Water Resources Div.
J. M. Knott, S. W. Lipscomb, and T. W. Lewis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-229, 1987. 51p, 26 fig, 5 tab, 18 ref.

Descriptors: *Sediment transport, *Alaska, *Susitna River, *Bed-load discharge, Bed load, Hydraulic properties, Suspended sediment, Channel width, Flow velocity, Streamflow, Sediment discharge, Yentna River, Chulitna River, Talkeetna River, Streams.

The upper reaches of the Susitna River have been considered for development of a large power generation system for south-central Alaska. Sediment and hydraulic data obtained from October 1984 to September 1985 (water year 1985) at selected sites on the Susitna, Chulitna, Talkeetna and Yentna Rivers are summarized. Sediment data include measurements of suspended sediment and bedload discharge, and analyses of particle size distribution of suspended sediment, bedload, and bed material; hydraulic data include measurements of channel width, average depth and velocity of water, and water surface slope. Relations between water and sediment discharge are developed for each site. Sediment loads for water year 1985 were estimated for the Yentna, Chulitna, and Talkeetna Rivers and for three sites on the Susitna River. About 31

million tons of sediment were transported to the Susitna River at Susitna Station during the year. The Yentna and Chulitna Rivers contributed about 21 million tons of sediment to the Susitna River. (Author's abstract)
W89-08992

AGGRADATION AND DEGRADATION OF ALLUVIAL SAND DEPOSITS, 1965 TO 1986, COLORADO RIVER, GRAND CANYON NATIONAL PARK, ARIZONA - EXECUTIVE SUMMARY,
Geological Survey, Tucson, AZ. Water Resources Div.
J. C. Schmidt, and J. B. Graf.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-561, April 1988. 15p, 4 fig, 4 tab, 6 ref.

Descriptors: *Suspended sediments, *Sand, *Alluvial deposits,, *Colorado River, *Erosion, *Arizona, *Grand Canyon National Park, Sediment transport, Streamflow.

High discharges that occurred in 1983-85 resulted in redistribution of sand stored in zones of recirculating current in the Colorado River in Grand Canyon National Park. Redistribution resulted in net loss in the number of reattachment deposits in narrow reaches and aggradation of some separation deposits. Separation deposits were more stable than other types of deposits. Alluvial sand deposits that are large enough and of sufficient areal extent for use as campsites were more stable than smaller lower-elevation deposits. Fluctuating flows between October 1985 and January 1986 caused erosion throughout the Grand Canyon and caused erosion of some deposits created by the high flows of 1983-85. (Author's abstract)
W89-08995

SUSPENDED SEDIMENT IN MINNESOTA STREAMS,
Geological Survey, St. Paul, MN. Water Resources Div.
L. H. Tornes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4312, 1986. 33p, 7 fig, 6 tab, 26 ref.

Descriptors: *Suspended load, *Suspended sediment, *Minnesota, *Streams, Sediment concentration, Baptism River, Root River, Mathematical equations, Sediment transport, Pelican River, Whitewater River, Deer Creek, Sediment load, Seasonal distribution, Sampling.

Suspended sediment samples have been collected by the U.S. Geological Survey from 115 sites on Minnesota streams since October 1960. Data from 42 sites were sufficient for characterizing sediment concentrations and yields. Average concentrations ranged from 4.4 mg/L on the Baptism River in northeastern Minnesota to 190 mg/L on the Root River in the southeast. Log-linear equations that describe the sediment transport curve were developed for 33 daily sediment stations and used to estimate long-term sediment yields. Average annual yields ranged from < 1.0 ton/sq mi on the Pelican River, to > 200 tons/sq mi on the Root and Whitewater Rivers and Deer Creek. Estimates indicated that under extreme circumstances the average annual sediment load for 2 years could be transported in slightly more than one day. Analysis showed that more than 90% of the annual sediment load was carried during 3 to 9 months of the year. On the average, almost 25% of the annual sediment load was transported during April. Generally, it was found that < 4% of the average annual load was transported during December, January, and February, which indicates that sampling frequency could be reduced during winter. (Author's abstract)
W89-09019

ANALYSIS OF SEDIMENT PRODUCTION FROM TWO SMALL SEMIARID BASINS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
J.G. Rankl.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4314, 1987. 27p, 15 fig, 5 tab, 11 ref.

Descriptors: *Sediment yield, *Erosion, *Rainfall-runoff relationships, *Erosion, *Semiarid lands, *Wyoming, Data collection, Sediment transport, Storm runoff, Streams, Stream gages, Model studies, Sediment load.

Data were collected at two small, semiarid basins in Wyoming to determine the relation between rainfall, runoff, and sediment production. The basins were Dugout Creek tributary and Saint Marys Ditch tributary. Sufficient rainfall and runoff data were collected at Dugout Creek tributary to determine the source of sediment and the dominant sediment production processes. Because runoff from only one storm occurred in Saint Marys Ditch tributary, emphasis of the study was placed on the analysis of data collected at Dugout Creek tributary. At Dugout Creek tributary, detailed measurements were made to establish the source of sediment. To determine the quantity of material removed from headcuts during the study, two headcuts were surveyed. Aerial photographs were used to define movement of all headcuts. The total quantity of sediment removed from all headcuts between September 26, 1982, and September 26, 1983, was estimated to be 1,220 tons, or 15%-25% of the estimated total sediment load passing the streamflow-gaging station. A soil plot was used to sample upland erosion. A rainfall and runoff modeling system was used to evaluate the interaction between the physical processes which control sediment production. The greatest change in computed sediment load was caused by changing the parameter values for equations used to compute the detachment of sediment particles by rainfall and overland flow resulted in very small changes in computed sediment load. The upland areas were the primary source of sediment. A relationship was developed between the peak of storm runoff and the total sediment load for that storm runoff. The sediment concentration used to compute the total sediment load for the storm runoff was determined from sediment samples collected by two automatic pumping samplers. The coefficient of variation of the relationship is 34% with a 0.99 correlation coefficient. (Author's abstract)
W89-09020

ESTIMATING ANNUAL SUSPENDED-SEDIMENT LOADS IN THE NORTHERN AND CENTRAL APPALACHIAN COAL REGION,
Geological Survey, Columbus, OH. Water Resources Div.
G. F. Koltun.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4215, 1985. 17p, 3 fig, 5 tab, 18 ref.

Descriptors: *Suspended load, *Appalachian Coal Region, *Coal mining, *Suspended sediments, *Sediment load, Mathematical studies, Regression analysis, Land use, Streamflow, Rainfall, Stream discharge, Flood peak, Mathematical equations.

Multiple regression equations were developed for estimating the annual suspended sediment load, for a given year, from small to medium-sized basins in the northern and central parts of the Appalachian coal region. The regression analysis was performed with data for land use, basin characteristics, streamflow, rainfall, and suspended sediment load for 15 sites in the region. Two variables, the maximum mean daily discharge occurring within the year and the annual peak discharge, explained much of the variation in the annual suspended sediment load. Separate equations were developed employing each of these discharge variables. Standard errors for both equations are relatively large, which suggests that future predictions will probably have a low level of precision. This level of precision, however, may be acceptable for certain purposes. It is therefore left to the user to assess whether the level of precision provided by these equations is acceptable for the intended application. (Author's abstract)
W89-09035

POST-ERUPTION CHANGES IN CHANNEL GEOMETRY OF STREAMS IN THE TOUTLE RIVER DRAINAGE BASIN, 1980-82, MT. ST. HELENS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
D. F. Meyer, K. M. Nolan, and J. E. Dodge.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-412, 1986. 128p, 17 fig, 3 tab, 20 ref.

Descriptors: *Sedimentation, *Erosion, *Volcanoes, *Channel morphology, *Toutle River, *Washington, *Mount St Helens, Drainage areas, Green River, Streamflow, Rivers, Bank erosion, Channel erosion, Data collections, Sedimentation, Cross-sections.

The May 18, 1980, eruption of Mount St. Helens, Washington, generated a debris avalanche, lateral blast, lahars, and tephra deposits that altered mainstem and tributary channels within the Toutle River drainage basin. Channel cross sections were monumented and surveyed on North Fork Toutle River and its tributaries, on South Fork Toutle River, on Green River, and on Toutle River in 1980 and 1981. These streams drain the north and west flanks of the volcano. The network of channel cross sections was surveyed more frequently following periods of higher flow. The repetitive cross-section surveys provide measurements of bank erosion or accretion and of channel erosion or aggradation. These data can be used to determine erosion rates, and to identify sources and storage sites of sediment in sediment budget computations. This report presents channel cross-section profiles constructed from the survey data collected during water years 1980 through 1982 in 200 figures. (Author's abstract)
W89-09093

CAPACITY AND SEDIMENTATION OF LOCH LOMOND RESERVOIR SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman, and K. L. Johnson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-485, 1985. 24p, 5 fig, 4 tab, 1 plate, 9 ref.

Descriptors: *Silting, *Storage capacity, *California, *Sedimentation, *Loch Lomond Reservoir, *Reservoir capacity, Santa Cruz, Surveys, Hydrologic data, Landslides, Silting.

A sedimentation study of Loch Lomond Reservoir in Santa Cruz County, California, was begun in 1982 to determine reservoir storage capacity and to establish permanent ranges for future studies. Results of a reservoir survey indicated a total storage capacity of 8,824 acre-ft in 1982. Comparison of thalweg profiles from this survey and a survey done prior to dam construction in 1960 shows that deposition has occurred in the lower reach of the reservoir due to landsliding and in the upper reach due to sediment inflow from Newell Creek. (Author's abstract)
W89-09095

SEDIMENTATION AND WATER QUALITY IN THE WEST BRANCH SHADE RIVER BASIN, OHIO, 1984 WATER YEAR,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress, and R. L. Jones.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-552, 1985. 26p, 5 fig, 5 tab, 7 ref.

Descriptors: *Sedimentation, *Water quality, *Shade River, *Ohio, Land reclamation, Sediment transport, Suspended sediments, Runoff, Hydrogen ion concentration, Sulfates, Metals, Coal mining.

Sedimentation in, and flooding of, the West Branch Shade River and its tributaries have been major concerns of residents and State and local officials. The area was extensively surface mined for coal between the mid-1940's and the early 1960's. Reclamation efforts immediately after mining were unsuccessful. The results have been elevated sediment loads and the subsequent loss of channel conveyance. Two sediment and stream gaging stations were established on West Branch Shade River in the area of past mining to provide data to evaluate the effectiveness of current reclamation activities on reducing sediment loads. A third station was established on the East Branch Shade River in an unmined area as a control. From October 1983 through September 1984, the annual suspended sediment yield/acre-ft of runoff was approximately two times as high for West Branch Shade River (0.51 ton/acre-ft of runoff) as for East Branch Shade River (0.28 ton/acre-ft). In addition, water quality of West Branch indicates that acidity is higher, pH is lower, and concentrations of dissolved sulfate and metals are higher than for East Branch. The concentration of coal in bed material increased in the downstream direction along West Branch Shade River. The concentration downstream in the West Branch was more than 20 times greater than in the East Branch. (Author's abstract)
W89-09099

SEDIMENT DATA FOR COMPUTATIONS OF DEPOSITION RATES IN THE TIDAL POTOMAC SYSTEM, MARYLAND AND VIRGINIA,
Geological Survey, Denver, CO. Water Resources Div.
J. L. Glenn, E. A. Martin, and C. A. Rice.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-318, (1986). 73p, 3 fig, 1 tab, 6 ref.

Descriptors: *Data collections, *Potomac River, *Sedimentation rates, *Maryland, *Virginia, *Sedimentation, Cores, Lead, Radioisotopes.

Sixty-two cores ranging in length from 33 to 1002 cm were collected from the tidal Potomac system and from selected tributaries downstream from the local head-of-tides between June 1978 and July 1981. Segments from selected depths below the sediment surface have been analyzed for a variety of constituents, including lead-210, trace metals, nutrients, and particle size. The core sites were positioned throughout the hydrologic divisions and geomorphic units of the tidal Potomac system and in water depths ranging from 1 to 30 cm. Cores collected by divers were mostly for historical deposition-rate computations. Vibra cores, as much as 12 m long, were collected primarily to provide data on long-term (pre-historical) sedimentation rates and conditions. Benthos cores were used to provide samples rapidly in locations where divers were not available. Alpha counting methods were used to determine the polonium-210 radioactivity and secular equilibrium was assumed between lead-210 and polonium-210. The alpha decay of polonium-210 provides a measure of the lead-210 radioactivity of the lead-210 produced by in-situ decay of radium-226 in the sediment column (background lead-210) and the lead-210 from external sources (unsupported lead-210). Only the unsupported lead-210 was used in computations of the deposition rate. The count error is based on the counting statistics alone and varies from 3 to 5% of the total number of counts. The background level of lead-210 in tidal Potomac system sediment cores usually is based on in-situ measurements of total lead-210 at depths below which no unsupported lead-210 is believed to be present, and the lead-210 concentrations are relatively constant. (Lantz-PTT)
W89-09128

SEDIMENT TRANSPORT CHARACTERISTICS OF SELECTED STREAMS IN THE SUSITNA RIVER BASIN, ALASKA, OCTOBER 1983 TO SEPTEMBER 1984,
Geological Survey, Anchorage, AK. Water Resources Div.
J. M. Knott, S. W. Lipscomb, and T. W. Lewis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-424W, 1986. 73p, 36 fig, 5 tab, 13 ref.

Descriptors: *Sediment transport, *Susitna River, *Sediment discharge, *Alaska, Water resources development, Chulitna River, Talkeetna River, Yentra River, Suspended sediment, Bed-load discharge, Flow velocity, Streamflow.

The upper reaches of the Susitna River have been considered for development of a large power generation system for south-central Alaska. This report presents a summary and discussion of sediment and hydraulic data obtained from October 1983 to September 1984 at ten sites on the Susitna, Chulitna, Talkeetna, and Yentna Rivers. Sediment data include measurements of suspended sediment and bedload discharge and analyses of particle size distribution of suspended sediment, bed-load, and bed material; hydraulic data include measurements of width, average depth and velocity, and water surface slope. Relations between water and sediment discharge are developed for selected sites. Sediment loads for the 1984 water year were estimated for the Yentna, Chulitna, and Talkeetna Rivers and for four sites on the Susitna River. About 25 million tons of sediment was transported by the Susitna River at Susitna Station during the 1984 water year. The Yentna and Chulitna Rivers contributed more than 20 million tons of sediment to the susitna River. About 90% of suspended material (silt, clay, and sand) transported past upstream sites reached Susitna Station during the same period. (Author's abstract)
W89-09135

SIMULATION OF THREE LAHARS IN THE MOUNT ST. HELENS AREA, WASHINGTON USING A ONE-DIMENSIONAL, UNSTEADY-STATE STREAMFLOW MODEL,
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen, and R. P. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4004, 1988. 20p, 5 fig, 7 tab, 22 ref.

Descriptors: *Simulation analysis, *Lahars, *Mount St Helens, *Streamflow, *Mud flows, *Model studies, *Washington, Hydrologic models, Channel flow, Detritus, Mathematical equations, Mathematical studies.

A one-dimensional, unsteady-state, open-channel model was used to analytically reproduce three lahar events. Factors contributing to the success of the modeling were: (1) the lahars were confined to a channel, (2) channel roughness was defined by field information, and (3) the volume of the flow remained relatively unchanged for the duration of the peak. Manning's 'n' values used in computing conveyance in the model were subject to the changing rheology of the debris flow and were calculated from field cross-section information (velocities used in these calculations were derived from super-elevation or run-up formulas). For the events modeled in this exercise, Manning's 'n' calculations ranged from 0.020 to 0.099. In all lahar simulations, the rheology of the flow changed in a downstream direction during the course of the event. Chen's 'U', the mudflow consistency index, changed approximately an order of magnitude for each event. The 'u' values ranged from 5-2,260 kg/m for three events modeled. The empirical approach adopted in this paper is useful as a tool to help predict debris-flow behavior, but does not lead to understanding the physical processes of debris flows. (Author's abstract)
W89-09143

FLOODING AND SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09179

BIOLOGICAL, MORPHOLOGICAL, AND CHEMICAL CHARACTERISTICS OF WAILUKU RIVER, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09196

DEBRIS FLOWS FROM TRIBUTARIES OF THE COLORADO RIVER, GRAND CANYON NATIONAL PARK, ARIZONA: EXECUTIVE SUMMARY,
Geological Survey, Tucson, AZ. Water Resources Div.
R. H. Webb.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-117, September 1987. 7p, 2 fig, 7 ref.

Descriptors: *Channel morphology, *Detritus, *Colorado River, *Sediment transport, *National parks, *Debris flows, *Arizona, *Grand Canyon, Streamflow, Clay, Particle size, Sand.

Debris flows are a major process of sediment transport to the Colorado River from ungaged tributaries in Grand Canyon National Park, Arizona. Debris flows are slurries of clay to boulder-sized particles of large magnitude and short duration that occur infrequently. They are the source for potential large volumes of sand for beaches on the Colorado River. Debris flows create and maintain hydraulic controls (rapids) on the Colorado River at tributary mouths. (See also W89-09240) (Author's abstract)
W89-09239

DEBRIS FLOWS FROM TRIBUTARIES OF THE COLORADO RIVER, GRAND CANYON NATIONAL PARK, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
R. H. Webb, P. T. Pringle, and G. R. Rink.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-118, September 1987. 64p, 20 fig, 12 tab, 43 ref.

Descriptors: *National parks, *Channel morphology, *Debris flows, *Detritus, *Colorado River, *Sediment transport, *Grand Canyon, *Arizona, Erosion, Crystal Creek, Sediment discharge, Particle size, Arid lands, Geologic formations, Stratigraphy, Flood peak, Flow discharge, Sand, Sediment sorting, Alluvial fans, Riffles.

A reconnaissance of 36 tributaries of the Colorado River indicates that debris flows are a major process by which sediment is transported to the Colorado River in Grand Canyon National Park. Debris flows are slurries of sediment and water that have a water content < 40% by volume. Debris flows occur frequently in arid and semiarid regions. Slope failures commonly trigger debris flows, which can originate from any rock formation in the Grand Canyon. The largest and most frequent flows originate from the Permian Hermit Shale, the underlying Esplanade Sandstone of the Supai Group, and other formations of the Permian and Pennsylvanian Supai Group. Debris flows have reached the Colorado River on an average of once every 20 to 30 yr in the Lava-Chuar Creek drainage since about 1916. Two debris flows have reached the Colorado River in the last 25 yr in Monument Creek. The Crystal Creek drainage has had an average of one debris flow reaching the Colorado River every 50 yr, although the debris flow of 1966 has been the only flow that reached the Colorado River since 1900. Debris flows may actually reach the Colorado River more frequently in these drainages because evidence for all debris flows may not have been preserved in the channel-margin stratigraphy. Discharges were estimated for the peak flow of three debris flows that reached the Colorado River. The debris flow of 1966 in the Lava-Chuar Creek drainage had an estimated discharge of 4,000 cu ft/sec. The debris flow of 1984 in the Monument Creek drainage had a discharge estimated between 3,600 and 4,200 cu

ft/sec. The debris flow of 1966 in the Crystal Creek drainage had a discharge estimated between 9,200 and 14,000 cu ft/sec. Debris flows in the Grand Canyon generally are composed of 10 to 40% sand by weight and may represent a significant source of beach-building sand along the Colorado River. The particle size distributions are very poorly sorted and the largest transported boulders were in the Crystal Creek drainage. Reworking of debris fans by the Colorado River creates debris bars that constrain the size of eddy systems and forms secondary rapids and riffles below tributary mouths. (See also W89-09239) (Lantz-PTT)
W89-09240

FORMATION AND FAILURE OF NATURAL DAMS,
Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 8D.
W89-09257

SUSPENDED-SEDIMENT CHARACTERISTICS OF INDIANA STREAMS, 1952-84,
Geological Survey, Indianapolis, IN. Water Resources Div.
C. G. Crawford, and L. J. Mansue.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-527, 1988. 79p, 21 fig, 15 tab, 45 ref.

Descriptors: *Indiana, *Suspended load, *Suspended sediments, *Indiana, *Streams, Stream discharge, Sediment transport, Particle size, Storm runoff, Low flow, Mathematical studies, Sediment yield.

Suspended sediment concentration and discharge data were collected at seven daily record stations and 70 partial record stations in Indiana during 1952-84. Median suspended sediment concentrations ranged from 24 to 61 mg/L at daily record stations; concentrations ranged from 6 to 539 mg/L at partial record stations. Most suspended sediment transported in Indiana streams is silt and clay size (particles between 0.062 and 0.004 and < 0.004 mm in diameter). Large suspended sediment concentrations were associated with storm runoff but not always with peak streamflow. Some peak concentrations of suspended sediment preceded peak streamflow by as much as 18 to 30 hr during storms. Suspended sediment concentrations frequently were largest during a storm that occurred after a period of low streamflow, when large amounts of sediment were eroded and transported into the stream and little base flow was available for dilution. For most of the streams studied, reliable predictive equations could not be developed to quantify the relation between suspended sediment concentration and streamflow because of the extreme variability in the data. Annual suspended sediment yields at four daily record stations ranged from 186 to 1,914 tons/sq mi. Annual suspended sediment yields for 70 partial record stations, estimated by use of the suspended sediment transport, flow-duration-curve method, ranged from 11 to 2,310 tons/sq mi. However, because of the poor correlation between suspended sediment discharge and streamflow, these estimates are poor. Periods of record at four daily record and 32 partial record stations were sufficient to test for trends. The trend in suspended sediment concentration, adjusted for streamflow, was significant for only nine of the 36 stations. At six of the nine stations, flow adjusted suspended sediment concentrations decreased with time. (Author's abstract)
W89-09268

2K. Chemical Processes

STATISTICAL SUMMARY OF THE CHEMICAL QUALITY OF SURFACE WATER IN THE POWDER RIVER COAL BASIN, THE HANNA COAL FIELD, AND THE GREEN RIVER COAL REGION, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. A. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 84-4092, 1988. 109p, 12 fig, 3 tab, 25 ref.

Descriptors: *Water quality, *Coal mine effects, *Statistical analysis, *Green River Coal Region, *Wyoming, Regression analysis, Dissolved solids, Calcium, Magnesium, Sodium, Bicarbonate, Chlorides, Sulfates, Powder River Coal Basin, Hanna Coal field.

A summary of the chemical quality of surface water in the three principal coal-producing areas of Wyoming was intensified by the U.S. Geologic Survey during 1975-81, in response to interest spurred by a dramatic increase in surface mining of the areas. This statistical summary consists of descriptive statistics and regression analyses of data from 72 stations on streams in the Powder River coal basin, the Hanna coal field, and the Green River coal region of Wyoming. The mean dissolved-solids concentrations in streams ranged from 15 to 4,800 mg/L. Samples collected near mountainous areas or in the upstream reaches of perennial streams in the plains had the smallest concentrations of dissolved solids, and the predominant ions were calcium and bicarbonate. Samples from ephemeral, intermittent, and the downstream reaches of perennial streams in the plains contained relatively large dissolved-solids concentrations, and the predominant ions usually were sodium and sulfate. Regression models showed that the concentrations of dissolved solids, calcium, magnesium, sodium, alkalinity, sulfate, and chloride correlated well with specific-conductance values in many of the streams. (USGS)
W89-08311

GEOHYDROLOGY OF THE FLATHEAD INDIAN RESERVATION, NORTHWESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08315

EVALUATION OF AVAILABLE DATA ON THE GEOHYDROLOGY, SOIL CHEMISTRY, AND GROUNDWATER CHEMISTRY OF GAS WORKS PARK AND SURROUNDING REGION, SEATTLE, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08356

ESTIMATION OF NATURAL DISSOLVED-SOLIDS DISCHARGE IN THE UPPER COLORADO RIVER BASIN, WESTERN UNITED STATES,
Geological Survey, Denver, CO. Water Resources Div.
D. K. Mueller, and L. L. Osen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4069, 1988. 62p, 9 fig, 26 tab, 29 ref.

Descriptors: *Dissolved solids, *Salinity, *Statistical methods, *Natural waters, *Water quality, Regression analysis, Statistical models, Colorado River basin, Western U.S.

A statistical method was developed to estimate monthly natural dissolved-solids discharge at selected sites in the Upper Colorado River Basin. Natural dissolved-solids discharge was defined as the rate of inorganic-solute flow past a specific site that would have occurred if there had been no water-resources development in the basin upstream from the site. The method used weighted least-squares regression to fit a model of dissolved-solids discharge as a function of streamflow and several variables representing development. After the model had been calibrated for an individual site, the development variables were assigned a value of zero to yield the relation between dissolved-solids discharge and streamflow for conditions of no upstream development. Natural dissolved-solids discharge was calculated using this relation and estimates of natural streamflow provided by the U.S. Bureau of Reclamation. Limitations of the method included lack of data to verify estimates of the natural dissolved-solids discharge and to represent all the effects of development adequately. However, model statistics indicated a good fit to historical data. Also, the estimates of natural dissolved-solids-discharge had the expected monthly distribution and were consistent between upstream and downstream sites. (USGS)
W89-08399

DISTRIBUTION OF GASES IN THE UNSATURATED ZONE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2G.
W89-08418

COMPUTER PROGRAM INCORPORATING PITZER'S EQUATIONS FOR CALCULATION OF GEOCHEMICAL REACTIONS IN BRINES,
Geological Survey, Reston, VA. Water Resources Div.
L. N. Plummer, D. L. Parkhurst, G. W. Fleming, and S. A. Dunkle.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4153, 1988. 310p, 1 fig, 17 tab, 43 ref.

Descriptors: *Thermodynamics, *Computer models, *Model studies, *Water chemistry, *Brines, *Solubility, Activity coefficient, Electrolytes, Mineral-water equilibria, Virial expansion, Equilibrium.

The program named PHRQPITZ is a computer code capable of making geochemical calculations in brines and other electrolyte solutions to high concentrations using the Pitzer virial-coefficient approach for activity-coefficient corrections. Reaction-modeling capabilities include calculation of (1) aqueous speciation and mineral-saturation index, (2) mineral solubility, (3) mixing and titration of aqueous solutions, (4) irreversible reactions and mineral water mass transfer, and (5) reaction path. The computed results for each aqueous solution include the osmotic coefficient, water activity, mineral saturation indices, mean activity coefficients, total activity coefficients, and scale-dependent values of pH, individual-ion activities and individual-ion activity coeffients, and scale-dependent values of pH, individual-ion activities and individual-ion activity coefficients. A data base of Pitzer interaction parameters is provided at 25 C for the system: Na-K-Mg-Ca-H-Cl-SO4-OH-HCO3-CO3-CO2-H2O, and extended to include largely untested literature data for Fe(II), Mn(II), Sr, Ba, Li, and Br with provision for calculations at temperatures other than 25C. An extensive literature review of published Pitzer interaction parameters for many inorganic salts is given. Also described is an interactive input code for PHRQPITZ called PITZINPT. (USGS)
W89-08459

OVERVIEW OF THE PHYSICAL-CHEMICAL PROCESSES IN THE FORMATION OF ACID PRECIPITATION,
MITRE Corp., McLean, VA. Jason Program Office.
For primary bibliographic entry see Field 5B.
W89-08514

STORM EVENT SAMPLING OF TWO LOW ALKALINITY SOUTHWESTERN ARKANSAS STREAMS,
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
For primary bibliographic entry see Field 2E.
W89-08517

EFFECT OF CORRELATED INPUTS ON DO UNCERTAINTY,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08549

SHAPE AND VARIABILITY OF THE ABSORPTION SPECTRUM OF AQUATIC HUMUS,
Technische Hogeschool Delft (Netherlands).
For primary bibliographic entry see Field 7B.
W89-08586

GROUND-WATER FLOW AND QUALITY NEAR CANON CITY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08618

CHEMICAL QUALITY OF GROUND WATER IN SACRAMENTO AND WESTERN PLACER COUNTIES, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08743

HYDRAULIC PROPERTIES OF ROCK UNITS AND CHEMICAL QUALITY OF WATER FOR INEL-1--A 10,365-FOOT DEEP TEST HOLE DRILLED AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO,
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08775

NUMERICAL SIMULATION OF ADVECTIVE-DISPERSIVE MULTISOLUTE TRANSPORT WITH SORPTION, ION EXCHANGE AND EQUILIBRIUM CHEMISTRY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08776

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF CRYSTALLINE-ROCK AQUIFERS OF ARCHEAN AND PROTEROZOIC AGE, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08783

STATISTICAL SUMMARY AND EVALUATION OF THE QUALITY OF SURFACE WATER IN THE COLORADO RIVER BASIN, 1973-82 WATER YEARS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08806

SELECTED METHODS FOR DISSOLVED IRON (II, III) AND DISSOLVED SULFIDE (-II) DETERMINATIONS IN GEOTHERMAL WATERS,
Geological Survey, Menlo Park, CA. Water Resources Div.
D. V. Vivit, and E. A. Jenne.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4189, 1985. 16p, 6 tab, 10 ref.

Descriptors: *Geothermal studies, *Water analysis, *Pollutant identification, *Iron, *Sulfides, *Chemical analysis, *Thermal springs, Geothermal resources, Mexico, Cerro Prieto, Spectrophotometry, Spectrometry.

Dissolved sulfide (-II) and dissolved iron (II, III) were determined in geothermal well water samples collected at Cerro Prieto, Mexico. Most samples consisted of liquid and gas (two phases) at the instant of collection; and a subset of samples, referred to as 'flashed' samples, consisted of pressurized steam samples which were allowed to condense. Sulfide was determined by sulfide specific ion electrode; Fe(II) and Fe(III) plus Fe(II) were determined spectrophotometrically. The precision and accuracy of the methods were evaluated for these high-silica waters with replicate analyses, spike recoveries, and an alternate method. Direct current (d.c.) argon plasma emission spectrometry was the alternate method used for Fe(III)-plus-Fe(II) analyses. Mean dissolved iron concentrations ranged from 20.2 to 834 micrograms/L (ug/L) as Fe(II) and 26.8 to 904 ug/L as Fe(III) plus Fe(II). Mean sulfide concentrations ranged from about 0.01 to 5.3 mg/L (S-II) Generally, higher S(-II) values and larger Fe(II)/Fe(III) ratios were found in the two-phase samples. These findings suggest that the 'flashed' samples are at a less reduced state than the two-phase samples. (Author's abstract)
W89-08811

AREAL AND TEMPORAL VARIATIONS IN THE QUALITY OF SURFACE WATER IN HYDROLOGIC ACCOUNTING UNIT 120301, UPPER TRINITY RIVER BASIN, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09023

WATER QUALITY IN THE ST. CROIX NATIONAL SCENIC RIVERWAY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
D. J. Graczyk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4319, 1986. 48p, 10 fig, 12 tab, 26 ref, 2 append.

Descriptors: *Water quality, *St Croix River, *Hydrologic data collections, *Wisconsin, Pesticides, Suspended sediments, Phosphorus, Trace metals, Iron, Manganese, Nitrogen, Dissolved solids.

A water quality study of the St. Croix National Scenic Riverway, was conducted during the period 1975-83. The water was shown to be good for most uses and is a calcium bicarbonate type. Concentrations of most constituents analyzed, and constituent loads and yields were lower in the Scenic Riverway than in other Wisconsin streams. Water quality samples were collected at 10 stations throughout the study area and were compared to analyses of samples from selected National Stream Quality Accounting Network stations (NASQAN) and the Hydrologic Bench-Mark Network (HBMN) station in Wisconsin. The average suspended sediment (SS) concentration for 9 of the 10 stations in this study was 7.7 mg/L. This compared with an average SS concentration of 11 mg/L for two other stations in the scenic riverway and an average SS concentration of 110 mg/L for Wisconsin. The concentrations of major cations and anions at two of the stations were similar to concentrations at the HBMN station Popple River near Fence. Mean total phosphorus concentrations ranged from 0.02 to 0.08 mg/L at the study stations and from 0.03 to 0.16 mg/L at selected NASQAN stations. Concentrations of trace metals were below safe drinking water standards at all the study sites, except for iron and manganese which exceeded drinking water standards at some of the study sites. Pesticides were sampled at the St. Croix River at St. Croix Falls and above and below cranberry bogs that drain into the Namekagon River. No pesticides were detected in the water/suspended sediment mixture or bottom material. Average annual loads of SS, total phosphorus, total nitrogen, and dissolved solids were calculated by a flow duration curve method. Annual SS loads ranged from 580 to 25,000 tons/yr at the study stations. Annual SS loads at the HBMN station and NASQAN stations ranged from 720 tons at the Popple River near Fence to 443,000 tons at the Chippewa River near Durand. Average annual total phosphorus loads ranged from 6,800 to 900,000 pounds at the study stations compared with 145,000 to 1,600,000 pounds at selected Wisconsin NASQAN stations. Suspended sediment yields ranged from 1.9 to 13.3 tons/sq mi. The average SS yield for Wisconsin is 80 tons/sq mi. Total phosphorus and other constituents exhibited the same trend. (Lantz-PTT)
W89-09024

PHYSICAL CHARACTERISTICS AND CHEMICAL QUALITY OF SELECTED SPRINGS IN PARTS OF JUAB, MILLARD, TOOELE, AND UTAH COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09028

SELECTED HYDROLOGIC DATA, KOLOB-ALTON-KAIPAROWITS COAL-FIELDS AREA, SOUTH-CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09070

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1981,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09080

CHEMICAL COMPOSITION OF GROUND WATER AND THE LOCATIONS OF PERMEABLE ZONES IN THE YUCCA MOUNTAIN AREA, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09082

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF ANDROSCOGGIN, CUMBERLAND, FRANKLIN, KENNEBEC, LINCOLN, OXFORD, SAGADAHOC, AND SOMERSET COUNTIES, MAINE: SAND AND GRAVEL AQUIFER MAPS 10, 11, 16, 17 AND 32,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09085

HYDROLOGIC AND GEOCHEMICAL DATA FOR THE BIG BROWN LIGNITE MINE AREA, FREESTONE COUNTY, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09091

SOLUTE GEOCHEMISTRY OF THE SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09126

QUALITY OF WATER FROM FRESHWATER AQUIFERS AND PRINCIPAL WELL FIELDS IN THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09178

WATEQ4F--A PERSONAL COMPUTER FORTRAN TRANSLATION OF THE GEOCHEMI-

Group 2K—Chemical Processes

CAL MODEL WATEQ2 WITH REVISED DATA BASE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09232

WATER-QUALITY ASSESSMENT OF THE CARSON RIVER GROUND-WATER BASIN, NEVADA AND CALIFORNIA: PROJECT DESCRIPTION,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09234

SURFACE-WATER-QUALITY ASSESSMENT OF THE YAKIMA RIVER BASIN, WASHINGTON: PROJECT DESCRIPTION,
Geological Survey, Tacoma, WA. Water Resources Div.
S. W. McKenzie, and J. F. Rinella.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-238, 1987. 35p, 2 fig, 7 tab, 1 plate, 30 ref.

Descriptors: *Surface water, *Water quality, *Data acquisition, *Yakima River, *Washington, *Water pollution sources, Project planning, Land use, Water sampling, Agriculture, Logging, Fisheries.

In April 1986, the U.S. Geological Survey began the National Water Quality Assessment program to: (1) provide a nationally consistent description of the current status of water quality, (2) define water quality trends that have occurred over recent decades, and (3) relate past and present water quality conditions to relevant natural features, the history of land and water use, and land management and waste management practices. At present (1987), The National Water Quality Assessment program is in a pilot studies phase, in which assessment concepts and approaches are being tested and modified to prepare for possible full implementation of the program. Seven pilot projects (four surface water projects and three groundwater projects) have been started. The Yakima River basin in Washington is one of the pilot surface water project areas. The Yakima River basin drains in area of 6,155 sq mi and contains about 1,900 river mi of perennial streams. Major land use activities include growing and harvesting timber, dryland pasture grazing, intense farming and irrigated agriculture, and urbanization. Water quality issues that result from these land uses include potentially large concentrations of suspended sediment, bacteria, nutrients, pesticides, and trace elements that may affect water used for human consumption, fish propagation and passage, contact recreation, livestock watering, and irrigation. Data will be collected in a nine year cycle. The first three years of the cycle will be a period of concentrated data acquisition and interpretation. For the next six years, sample collection will be done at a much lower level of intensity to document the occurrence of any gross changes in water quality. This nine year cycle would then be repeated. Three types of sampling activities will be used for data acquisition: fixed location station sampling, synoptic sampling, and intensive reach studies. (Lantz-PTT)
W89-09248

2L. Estuaries

INTERACTION BETWEEN ESTUARINE PLUMES AND CONTINENTAL SHELF WATERS,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
Q. Zhang.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8529464. Ph.D. Dissertation, 1985. 67p, 32 fig, 22 ref.

Descriptors: *Flow characteristics, *Sediment transport, *Sedimentation, *Estuaries, *Continental shelf, *Model studies, *Plumes, Mathematical models, Bottom water, Differential equations, Flow friction.

Flow conditions between estuaries and continental shelf waters were modeled based on a steady state, two-layer fluid, while disregarding horizontal friction. Vertical friction is assumed to be of at least comparable importance to that of inertia, but only in the thin Ekman layers near the interface of the two layers and the sea bottom. In the interior regions away from the Ekman layers, frictional effects can be neglected. Through dimensional analysis it is shown that vertical velocities are equal to zero in the interior regions. Thus, the vertical components of velocity of the fluid particle at the sloping bottom and at the interface of the two fluid layers are absorbed, or, in effect, balanced respectively by the Ekman pumping action in the corresponding Ekman layers. Accordingly, two partial differential equations governing the stream functions in the two interior regions are obtained. When the sea bottom is unidirectional and uniformly sloping away from the shore, distributions are obtained of stream functions in the two layers and the displacement of the interface. The solutions are expressed explicitly in terms of a Fourier integral and contain an arbitrary constant, which is used to match up with ambient coastal flow which may exist on the adjacent continental shelf, without concern for the origin of the flow. (Cremmins-AEPCO)
W89-08255

NUMERICAL MODELING OF TIDE AND CIRCULATION IN CENTRAL PUGET SOUND: COMPARISON OF A THREE-DIMENSIONAL AND A DEPTH-AVERAGED MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
W. Chu, J. Liou, and K. D. Flennikan.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115497/AS, price codes: A04 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Technical Completion Report, Jun 1988. 51p, 19 fig, 2 tab, 39 ref. USGS contract 14-08-0001-G1456. USGS project G1456-05.

Descriptors: *Model studies, *Computer models, *Mathematical models, *Tides, *Tidal currents, *Puget Sound, Depth-averaged model, Three-dimensional model, Washington, Tidal hydraulics.

As an attempt to understanding the tidal hydraulics and transport characteristics of Puget Sound better, a depth-averaged and a three-dimensional hydrodynamics model were developed and evaluated. To limit the area of application in this initial investigation, the models were applied to a part of Puget Sound from Point Wells to the Narrow at Tacoma, referred to in this study as Central Puget Sound. The objective of the investigation was to compare the model's capabilities to characterize the tide and tidal current in this area of Puget Sound and their computational requirements. Both models were shown to be capable of reproducing major observed tide and tidal current characteristics in Central Puget Sound. The study revealed that at the spatial resolution of 762m, the difference between the results of the two models is small. Typical runs of the models with the current resolution require 5 to 20 CPU minutes on a CRAY X/MP-48 supercomputer. For general tidal circulation and transport studies with a desired resolution of 750m or more, the use of the depth-averaged model which requires three times less computing resources is recommended. For certain engineering and planning problems around the Sound which require more detailed knowledge of the tidal current, the use of the three-dimensional model with finer spatial resolution (250m or less horizontally and 15 to 50m vertically) is suggested. The study has shown that with the increasing availability of computer power, the use of multi-dimensional hydrodynamics models for estuarine environmental decision making and basic scientific research is promising. (USGS)
W89-08352

BENTHIC MACROFAUNA AND ANCILLARY DATA FOR SAN FRANCISCO BAY, CALIFORNIA, MARCH TO NOVEMBER 1987,
Geological Survey, Menlo Park, CA. Water Resources Div.
L. E. Schemel, A. Y. Ota, J. G. Harmon, J. M. Shay, and R. N. Adorador.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-192, 1988. 73p, 1 fig, 7 tab, 5 ref.

Descriptors: *Benthic fauna, *San Francisco Bay, Benthic macrofauna, Water properties, Nutrient concentrations.

Benthic macrofauna and ancillary data were collected during 1987 as part of the U.S. Geological Survey Regional Effects Monitoring Program in San Francisco Bay, California. Data were collected during five cruises at 2-month intervals from March through November. Benthic macrofauna for identification of species and sediment for size analysis were sampled at eight stations. Ancillary data, which consisted of salinity, temperature, dissolved-oxygen concentrations, and suspended sediment, were collected at 12 stations. Salinity and temperature were measured at three stations that coincided with continuous water quality monitors. Abundances and geographical distributions of a newly introduced species of clam were measured. (USGS)
W89-08389

HYDROLOGIC DATA FOR THE SALT BAYOU ESTUARY NEAR SABINE PASS, TEXAS, OCTOBER 1984 TO MARCH 1986,
Geological Survey, Houston, TX. Water Resources Div.
J. C. Fisher.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-499, 1988. 119p, 19 fig, 10 tab, 9 ref.

Descriptors: *Estuaries, *Hydrologic budget, *Hydrologic data, Southeast Texas.

The Salt Bayou estuary, located in extreme Southeast Texas near Sabine Pass, Texas has been altered by construction of the Gulf Intracoastal Waterway. The waterway has interrupted the historical saltwater-freshwater exchange of this important estuary. There have been proposals to develop water control structures in the major channels that would enable some regulation of the saltwater in the estuary. A cooperative effort was initiated by the Louisiana Cooperative Fish and Wildlife Research Unit, the U.S. Fish and Wildlife Service, the Texas Department of Parks and Wildlife and the U.S. Geological Survey to identify the fish species and their transport mechanisms. The U. S. Geological Survey's part of the study was to describe the hydrology of Salt Bayou. The initial data collection network consisted of stage gages at Keith Lake Pass, the mouth of Salt Bayou, Tenmile Cut, the Intracoastal Waterway, and Star Lake. After six months of data were collected the Tenmile Cut gage was moved to Wildcow Bayou. The gages at Keith Lake Pass, the mouth of Salt Bayou, Tenmile Cut, and Wildcow Bayou also were equipped with water velocity recording equipment. The Keith Lake Pass gage also had temperature and specific conductance recording equipment. Six 24-hour flow investigations were performed to calibrate the velocity recording equipment and to determine the flow at ungaged sites. Specific conductance and temperature were measured at 43 sites within the estuary. Precipitation data were obtained from the National Oceanic and Atmospheric Administration stations at Port Arthur, Anahuac, and Sea Rim State Park and were used to estimate the contribution of freshwater from rainfall. Evaporation data were obtained from the Beaumont Research Station and used to make estimates obtained from the National Oceanic and Atmospheric Administration weather station at Sea Rim State Park. (USGS)
W89-08393

PRACTICAL HANDBOOK OF MARINE SCIENCE.
CRC Press, Inc., Boca Raton, Florida. 1989. 710p.
Edited by Michael J. Kennish.

Descriptors: *Oceanography, *Marine science, *Marine biology, *Marine environment, *Handbooks, Air-water interfaces, Engineering, Phytoplankton, Primary productivity, Zooplankton, Marine geology.

This book contains over 700 pages of selected physical, chemical and biological reference data on the ocean environment. Major subject areas include air-sea interactions, chemical oceanography, physical oceanography, marine geology, ocean engineering, phytoplankton, primary productivity, zooplankton, and compounds from marine organisms. (Lantz-PTT)
W89-08468

ESTUARINE ECOSYSTEMS: A SYSTEMS APPROACH. VOLUME I,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
G. A. Knox.
CRC Press, Inc., Boca Raton, Florida. 1986. 289p.

Descriptors: *Systems analysis, *Estuaries, *Ecosystems, Mixing, Primary productivity, Microbiological studies, Zooplankton, Organic matter, Algae, Birds, Benthic environment, Salt marshes, Salinity, Saline-freshwater interfaces, Estuarine environment, Food chains.

Estuaries have often been subjected to the most intensive use applied to any marine area. Channelization, reclamation, development of ports and marinas, and waste discharges have irreversibly altered the nature of many estuarine systems. Earlier work tended to concentrate on life in estuaries, but in more recent years the focus of much of the research has been on an understanding of the processes which control productivity and dynamic functioning. This emphasis on processes such as primary production, grazing, predation, secondary production, decomposition, detritus formation, role of dissolved organic matter, decomposition and the role of microorganisms, food webs, energy flow, nutrient cycling, and so on are the topics that are dealt with in these volumes. This, Volume I, contains information on: the estuarine environment--geomorphological features, estuarine sediment, estuarine circulation and salinity patterns, distribution patterns of estuarine organisms; primary productivity--salt marshes, mangrove systems, macroalgae, seagrass systems, epiphytic algae, benthic microalgae, phytoplankton, relative contributions of the various producers; detritus and the role of microorganisms--particulate organic matter, dissolved organic matter, role of microorganisms, microorganisms as a food resource; and, consumers--zooplankton, nekton, benthic fauna, estuarine birds, factors controlling estuarine benthic community structure. (See also W89-08471) (Lantz-PTT)
W89-08470

ESTUARINE ECOSYSTEMS: A SYSTEMS APPROACH. VOLUME II,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
G. A. Knox.
CRC Press, Inc., Boca Raton, Florida. 1986. 230p.

Descriptors: *Systems analysis, *Estuaries, *Ecosystems, Cycling nutrients, Carbon, Food chains, Model studies, Mangroves, Salt marshes, Sea grasses, Simulation analysis, Primary productivity, Secondary productivity.

Estuaries have often been subjected to the most intensive use applied to any marine area. Channelization, reclamation, development of ports and marinas, and waste discharges have irreversibly altered the nature of many estuarine systems. Earlier work tended to concentrate on life in estuaries, but in more recent years the focus of much of the research has been on an understanding of the processes which control productivity and dynamic functioning. This emphasis on processes such as primary production, grazing, predation, secondary production, decomposition, detritus formation, role of dissolved organic matter, decomposition and the role of microorganisms, food webs, energy flow, nutrient cycling, and so on are the topics that are dealt with in these volumes. This, Volume II, contains information on: material cycling--nutrient cycling in salt marsh ecosystems, nutrient fluxes in mangrove ecosystems, models of mangrove nutrient interactions, nutrient cycling in seagrass ecosystems, sediment--water interactions in nutrient dynamics, nitrogen cycling at estuarine interfaces, interaction of freshwater input, tidal flushing, and phytoplankton production, salt marsh fertilization and shellfish production; carbon flow and estuarine food webs--energy budgets for single species, secondary production of the benthic macrofauna, secondary production of the microfauna and meiofauna, relative contributions of the various benthic infaunal groups to secondary production, community metabolism, trophic structure and estuarine food webs, energy flow and carbon budgets; estuarine/shelf interactions--export/import studies; modeling and systems analysis--mangrove ecosystems, salt marsh ecosystems, seagrass ecosystems, estuarine ecosystem models, the Peel-Harvey estuarine systems; alternative approaches to understanding ecosystem dynamics; and the future of ecosystem approaches and simulation modeling. (See also W89-08470) (Lantz-PTT)
W89-08471

OBSERVATIONS OF CURRENTS, SURFACE WINDS AND BOTTOM PRESSURE IN SHELIKOF STRAIT, AUTUMN 1984,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. T. Roach, J. D. Schumacher, and P. Stabeno.
Available from the National Technical Information Service, Springfield, VA 22161. NOAA Technical Memorandum ERL PMEL-74, July 1987. 116p, 78 fig, 17 tab, 16 ref.

Descriptors: *Marine fisheries, *Estuarine fisheries, *Wind-driven currents, *Shelikof Strait, *Water currents, *Tidal currents, Alaska, Straits, Upwelling, Wind tides, Ocean circulation, Fish.

An extensive array of current meters and bottom pressure gages was deployed in Shelikof Strait, Alaska, during 1984/85 as part of the Fisheries Oceanography Coordinated Investigations (FOCI). FOCI is aimed at understanding the physical and biological environment surrounding the early life stages of the Pacific pollock (theragra chalcogramma). These data, as well as calculated surface wind time series, were analyzed to investigate the influence of the Alaska Coastal Current (ACC) in this region. The ACC induced a strong mean flow (15 to 25 cm/s) during this season, concentrated along the Alaska Peninsula on the northern side of the Strait. Outside the influence of the ACC, mean currents were weak (5-8 cm/s). This highly variable flow bifurcated in the vicinity of the Semidi Islands, with 75% of the ACC volume flux flowing seaward out of a deep (200+m) sea valley which meets the shelf break at a sill southwest of Kodiak Island. This strong outflow can induce an estuarine type circulation through entrainment of bottom water causing a mean inflow at depth. The remainder of the flow continues along the Alaska Peninsula. The currents were generally well correlated in the vertical at each mooring, while the horizontal correlations were weak, indicating the horizontal spatial scales of coherence were < 8 to 15 km mooring separation. Surface winds from a location near the Barren Islands (200 km north of the Strait) showed the strongest relation to currents and transport. There was an indication that the winds drove the pressure differences and thereby the currents, as there was a significant correlation between bottom pressure differences and currents. (Author's abstract)
W89-08502

SOUTH BISCAYNE BAY WATER QUALITY: A TWELVE YEAR RECORD FOR BISCAYNE NATIONAL PARK,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08519

ROLE OF BACTERIA IN ORGANIC MATTER FLUXES IN THE SOUTHERN CALIFORNIA COASTAL ZONE,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
F. Azam.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-007060, price codes: A02 in paper copy, A01 in microfiche. Report No. DOE/ER/60337-1, June 1986. 11p, 4 fig. DOE Grant DE-FG05-85ER60337.

Descriptors: *Bacteria, *Coastal waters, *Euphotic zone, *Secondary productivity, *California, Carbon, Primary productivity, Biological studies, Chlorophyll a, Phytoplankton, Tritium, Amino acids, Algae, Benthic environment.

The purpose of measuring bacterial secondary production (BSP) was to determine the importance of heterotrophic bacterioplankton as a route for carbon flux in the study area. Three detailed depth-profiles almost to the bottom were taken in the Santa Monica Basin in May, 1986. In a depth profile of BSP for station 305, the range of BSP in the euphotic zone was 480,000-2,160,000 cells/sq m/d, corresponding to a carbon flux into bacteria of 0.94 g carbon/sq m/d. Primary production at this station was 1.25 g carbon/sq m/d. This means that within the euphotic zone bacterial production required 74% of the primary production. At stations 303 (about 8 km offshore) and 305 only 2-7% of BSP was associated with attached bacteria (those retained by 0.8 micrometer Nuclepore filters; a fraction of these may be free-living but large). Therefore, the contribution of attached bacteria to BSP was trivial. Data on BSP and bacterial enumeration showed that within the euphotic zone the bacterial (average) generation time range was 25.8-52.4 hr. Below the euphotic zone bacterial growth was much slower. However, BSP was significantly correlated with primary production ($r=0.77$; $P=0.01$), but did not show a significant correlation with either chlorophyll a or pheopigments. This may mean that photosynthesis-related processes (e.g., exudation by phytoplankton) rather than biomass-related processes (algal lysis, sloppy-feeding, etc.) were more important in carbon flux from phytoplankton to bacterioplankton. In October 1985, 3H-glutamic acid was employed as a tracer to study spatial trends in microbial utilization of dissolved free amino acids (DFAA), particularly onshore-offshore differences and the presence and persistence of the benthic boundary layer feature. Incorporation of glutamic acid in the central basin is most rapid in the euphotic zone (10 and 40 m deep) where DFAA sources, such as algal exudation, are predominant. Below the deep-water minimum in incorporation, a pronounced benthic boundary layer activity is observed. The percent of glutamic acid utilized which is respired is also highest in the euphotic zone (30-50%), usually in the mid- to deep waters and often increasing again at the benthic boundary layer. Further studies involved comparisons of tracers such as tritium and carbon-14 for use in these studies. (Lantz-PTT)
W89-08529

ORGANIC POLLUTION OF THE WATER IN THE BLACK CREEK VICINITY, BISCAYNE NATIONAL PARK,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5B.
W89-08532

SALT MARSH MONITORING AROUND SULLOM VOE IN 1986,
Shetland Oil Terminal Environmental Advisory Group, Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W89-08534

CANAL DISCHARGE IMPACTS ON BISCAYNE BAY SALINITIES, BISCAYNE NATIONAL PARK,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. C. Fatt, and J. D. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-213673. Price codes: A10 in paper copy, A01 in microfiche. National Park Service Research/Resources Management Report SER-89, December 1987. 229p, 57 fig, 7 tab, 19 ref. National Park Service Contract CX5000-4-1097.

Descriptors: *Bays, *Influent water, *Salinity, *National parks, *Mathematical models, Biscayne Bay, Mixing, Canals, Prediction, Advection, Mathematical equations, Hydrodynamics.

A two-dimensional finite element numerical model to simulate transport in an advection-dominated shallow estuarine bay was developed. This model predicts the salinity distribution in the bay for any prescribed rate of freshwater inflow and initial salinity distribution. The model solve the transport equation, using a two-part fractional step method together with an Eulerian-Lagrangian method of characteristics. This method eliminates the numerical problems inherent in previous techniques applied to advection-dominated transport. Hydrodynamic information needed to solves the transport equation was obtained from an existing two-dimensional Finite Element hydrodynamic model, CAFE. Freshwater inflow at six canal mouths was prescribed as sources in both the hydrodynamic and transport models. Actual freshwater discharges at each canal and synoptic salinity measurements were used to calibrate and verify the transport model. The general isohaline structures in the predicted salinity distributions from the model compared well with measured salinity distributions. However, the model salinities were on the order of 2 parts per thousand lower than measured salinities. This may be attributed to either the absence of evaporation and wind effects in the model or to measurement uncertainties. The model was used to investigate impacts of a contemplated doubling of freshwater inflow rates. Comparison between these predictions and existing conditions, allowed a quantitative determination of the impact of increased canal discharges on salinity distributions in the bay. Model results predict an overall decrease in salinity of 2 ppt when discharges at each canal are doubled. (Author's abstract)
W89-08540

PHOTO-INTERPRETATION OF WETLAND VEGETATION IN THE LESSER ANTILLES,
Office National des Forets, Basse-Terre (Guadeloupe).
For primary bibliographic entry see Field 7B.
W89-08576

REMOTE SENSING OF FLOW CHARACTERISTICS OF THE STRAIT OF ORESUND,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 7C.
W89-08592

ANALYSIS OF LANDSAT MULTISPECTRAL-MULTITEMPORAL IMAGES FOR GEOLOGIC-LITHOLOGIC MAP OF THE BANGLADESH DELTA,
International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).
For primary bibliographic entry see Field 7C.
W89-08598

SATELLITE REMOTE SENSING OF THE COASTAL ENVIRONMENT OF BOMBAY,
Indian Inst. of Tech., Bombay.
For primary bibliographic entry see Field 7C.
W89-08602

HYDROLOGIC AND OCEANOGRAPHIC APPLICATIONS OF REMOTE SENSING,
Dundee Univ. (Scotland). Physics Lab.
For primary bibliographic entry see Field 7B.
W89-08610

ALGAE AND HUMAN AFFAIRS.
For primary bibliographic entry see Field 2H.
W89-08612

MARINE DINOFLAGELLATE BLOOMS: DYNAMICS AND IMPACTS,
Florida Dept. of Natural Resources, St. Petersburg, FL. Bureau of Marine Research.
For primary bibliographic entry see Field 5C.
W89-08615

SIMULATION OF UNSTEADY FLOW IN THE MILWAUKEE HARBOR ESTUARY AT MILWAUKEE, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08798

SEDIMENT ACCUMULATION IN SAN LEANDRO BAY, ALAMEDA COUNTY, CALIFORNIA, DURING THE 20TH CENTURY--A PRELIMINARY REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-08802

FLOOD ESTIMATION FOR AN UNGAGED FLOODPLAIN,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2E.
W89-08869

SPATIAL AND TEMPORAL FACTORS CONTROLLING OVERTOPPING OF COASTAL RIDGES,
Florida State Univ., Tallahassee. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W89-08883

STATISTICAL ANALYSIS OF STORM TIDE ELEVATIONS FOR NEW ENGLAND COASTAL COMMUNITIES,
Stone and Webster Engineering Corp., Boston, MA.
For primary bibliographic entry see Field 2E.
W89-08884

ERRORS DUE TO LINEARIZATION IN TIDAL PROPAGATION,
South Florida Water Management District, West Palm Beach.
P. D. Scarlatos, and V. P. Singh.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 257-269, 6 fig, 1 tab, 7 ref.

Descriptors: *Tidal hydraulics, *Mathematical models, *Model studies, *Tides, *Numerical analysis, *Flooding, Sediment transport, Linear programming, Nonlinear programming, Tidal amplitude, Water depth, Convection, Bottom sediments, Calibration, Estuarine environment, Ecological effects, Salinity currents, Path of pollutants, Error analysis.

Propagation of tidal disturbance is simulated using the St. Venant system of equations which is a partial differential, nonlinear system of hyperbolic type and can be solved by means of numerical methods. However, certain assumptions can reduce the system into the linearized form of Telegrapher's equation, so that a closed-form solution is feasible. This linearization suppresses the tidal distortion induced by water shallowness, convectional velocities and bottom friction. Another source of error is the semi-empirical calibration of the linearized harmonic parameters. Underestimation of tidal processes in an estuarial impact study may cause environmental and ecological problems. Flooding, sediment transport, salinity intrusion, and pollutant diffusion are all closely related to tidal oscillatory flow. The nonlinear distortion is investigated for a large number of numerically simulated cases. The independent variables are bottom friction, tidal amplitude, mean water depth, and length of the waterway. Deviations of the harmonic solution from a finite element numerical solution are determined, and the risk of obtaining inaccurate results by using Telegrapher's equation is assessed. (See also W89-08863) (Author's abstract)
W89-08885

FLOOD MANAGEMENT IN THE NETHERLANDS FROM THE MIDDLE AGES TO THE SPACE ERA,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 4A.
W89-08886

WATER QUALITY: PROBLEMS AND NEEDS FOR INTEGRATED CONTROL IN BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 5G.
W89-08920

WATER QUALITY DATA FOR SELECTED STREAMS TRIBUTARY TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09068

PLANKTON STUDIES IN SAN FRANCISCO BAY. IV: PHYTOPLANKTON ABUNDANCE AND SPECIES COMPOSITION, JANUARY 1980-FEBRUARY 1981,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09221

TEMPORAL VARIATIONS IN THE BENTHIC COMMUNITIES AT FOUR INTERTIDAL SITES IN SAN FRANCISCO BAY, CALIFORNIA, 1983-85,
Geological Survey, Menlo Park, CA. Water Resources Div.
D. R. Hopkins.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-387, 1987. 89p, 21 fig, 5 tab, 15 ref.

Descriptors: *California, *Temporal distribution, *Benthic environment, *Estuaries, *Intertidal areas, *San Francisco Bay, Seasonal variation, Benthic fauna, Salinity, Species composition.

Benthic core samples were collected monthly from January 1983 through January 1985 at four intertidal sites in San Francisco Bay, California, two in the northern part of the bay (North Bay) and two in the southern part of the bay (South Bay). Considerable variation was observed in numbers of species and individuals at the four sites, and abundances within species varied widely. Temporal changes in species abundances appeared to be related to freshwater inflow patterns and resultant salinity variations in the estuary. The 1982-83 winter season was extremely wet, with heavy freshwater inflow to the bay from January through March, whereas the 1983-84 winter was closer to a normal pattern, with most rainfall occurring from November through January. Species were grouped into four categories depending on their patterns of abundance during the 2-yr period. Species that showed an abundance peak in the North Bay in 1983 only were Corophium sp.B and a Chironomidae larva, apparently responding to the extended period of lowered salinity throughout spring and early summer. Species with an abundance peak

only in 1984 included Corophium Acherusicum, Eteone californica, Nereis succinea, and Grandidierella japonica, typical estuarine species that might have been suppressed during the extended freshwater inflows in 1983. Species with peaks in both years were Gemma gemma and Ampelisca abdita in the South Bay; both showed strong seasonal variations. A number of species in both North and South Bays, including dominant members of the intertidal community such as Macoma balthical and Streblospio benedicti, did not show any consistent seasonal or year-to-year trends. Results of this study suggest that the intensity and timing of freshwater inflow to San Francisco Bay, particularly higher-than-normal inflow during late spring and early summer, may be an important factor in determining the composition of the intertidal benthic communities. (Author's abstract)
W89-09256

REVIEW OF CIRCULATION AND MIXING STUDIES OF SAN FRANCISCO BAY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
L. H. Smith.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-534, 1987. 38p, 16 fig, 2 tab, 36 ref.

Descriptors: *Mixing, *Water circulation, *San Francisco Bay, *Bays, *California, *Tidal currents, Seasonal variation, Salinity, Gravity, Estuaries, Runoff, Deltas.

A description of the major characteristics and remaining unknowns of circulation and mixing in San Francisco Bay has been constructed from a review of published studies. Description of net circulation and mixing over a few days to a few months illustrates best the interactions of major components. The discharge of the Sacramento-San Joaquin Delta into Suisun Bay is approximately 90% of the freshwater inflow to San Francisco Bay. Annual delta discharge is characterized by a winter season of high runoff and a summer season of low runoff. For the period 1956 to 1985 the mean of monthly discharges exceeded 1,000 cu m/s (35,000 cu ft/s) for the months of December through April, whereas for July through October, it was < 400 cu m/s (14,000 cu ft/s). The months of November, May, and June commonly were transition months between these seasons. Large year-to-year deviations from this annual pattern have occurred frequently. Much less is known about the ocean-bay exchange process. Net exchanges depend on net seaward flow in the bay, tidal amplitude, and longshore coastal currents, but exchanges have not yet been measured successfully. The bay is composed of a northern reach, which is strongly influenced by delta discharge, and South Bay, a tributary estuary which responds to conditions in Central Bay. In the northern reach net circulation is characterized by the river-induced seaward flow and a resulting gravitational circulation in the channels, and by a tide and wind-induced net horizontal circulation. During low delta discharges South Bay has nearly the same salinity as Central Bay and is characterized by tide and wind-induced net horizontal circulation. In the northern reach a nontidal current null zone moves rapidly seaward in response to increases in delta discharge, and after runoff events returns landward over a few months. During the low-discharge period the northern reach achieves an approximate salt balance in two to three months. When gravitational circulation penetrates these zones during high discharges, the mean residence time probably is reduced to less than a month. (Lantz-PTT)
W89-09271

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVERSE OSMOSIS MEMBRANES BASED ON HYDROXYALKYL METHACRYLATE AND METHACRYLIC ACID COPOLYMERS,
Rohm and Haas Co., Philadelphia, PA.
P. Osei-Gyimah, P. G. Cartier, and P. E. Ellis.
U.S. Patent No. 4,415,455; November 15, 1983, 5p, 1 tab. Official Gazette of the United States Patent Office, Vol 1037, No 3, p 1063, November 15, 1983.

Descriptors: *Patents, *Reverse osmosis, *Semipermeable membranes, *Desalination, Membrane processes, Substrates, Thin films, Polymers, Water treatment, Permselective membranes.

Semipermeable reverse osmosis membranes, adapted for use in desalination processes, exhibit good flux, high salt rejection, and high resistance to chemical and biological degradation. The membranes are produced using a composite comprising a microporous substrate and an ultrathin film, which is deposited on one surface of the substrate. The film is formed by contacting the substrate with a solution containing a catalyst, a copolymer of methacrylic acid, and an ester or amide of methacrylic acid, which contains a free hydroxyl group on the ester or amide moiety and optionally a polyfunctional carboxylic acid. The coated substrate is heated to form the permselective membrane. The coatings are not chemically bound to the substrate, but do penetrate to some degree into the substrate surface. (Cremmins-AEPCO)
W89-08276

MEMBRANE FOR REVERSE OSMOSIS AND METHOD OF MAKING THE SAME,
Juichiro Ozawa (Japan). (Assignee).
Y. Hayashi.
U.S. Patent No. 4,347,139; August 31, 1982, 6p, 2 fig, 4 tab, 1 ref. Official Gazette of the United States Patent Office, Vol 1021, No 5, p 1761-1762, August 31, 1982.

Descriptors: *Patents, *Reverse osmosis, *Desalination, *Wastewater treatment, *Membrane filters, Nitrogen, Polymers, Membrane processes, Separation techniques.

Membranes for reverse osmosis pass aqueous solutions and remove ionic substances, such as sodium chloride and inorganic salts of heavy metals, at high rates during the desalination of seawater and the treatment of wastewater. The membranes comprise a porous base to which is attached a thin high polymer film. The film includes at least one layer of a radical polymer of nitrogen containing monomer and alkyl metal and at least one layer of a polymer of nitrogen containing monomer, which are alternately laminated together. One porous base is placed in a plasma created by a glow discharge before introducing alternately a first polymerization reaction feed. The feed includes the nitrogen containing monomer, the alkyl metal, and an inert carrier gas. A second polymerization reaction feed only includes the nitrogen containing monomer and the inert carrier gas, which alternately cause a radical polymerization reaction on the porous base between the nitrogen containing monomer and alkyl metal and a polymerization reaction of the nitrogen containing monomer. (Cremmins-AEPCO)
W89-08282

SEMIPERMEABLE MEMBRANES,
Bayer A.G., Leverkusen (Germany, F.R.).
K. Elfert.
U.S. Patent No. 4,383,923; May 17, 1983, 6p, 1 tab. Official Gazette of the United States Patent Office, Vol 1030, No 3, p820, May 17, 1983.

Descriptors: *Patents, *Semipermeable membranes, *Reverse osmosis, *Ultrafiltration, *Polymers, Separation techniques, Membrane processes, Desalination, Wastewater treatment.

Semipermeable compound membranes for use in reverse osmosis and ultrafiltration consist of a polymer material having urazole structures. The polymer is the polycondensation product of trishydroxyethylurazole and/or trisglycidylurazole. A comonomer is selected from the group consisting of furfuryl alcohol, tetrahydrofurfuryl alcohol, benzyl alcohol, formaldehyde, furfuryl aldehyde, ethylene glycol, diethylene glycol, polyethylene glycol, butane diol, glycerine, trimethylol propane, pentaerythritol, sorbitol, mannitol, dianhydrosorbitol, citric acid, tartaric acid, glycolic acid, and hexamethoxymethyl, melamine. The proportion of compounds and/or their water soluble reaction products amounts to approximately 20% by weight, based on the total quantity of monomers used to produce the polymer material. (Cremmins-AEPCO)
W89-08283

3B. Water Yield Improvement

RECHARGE TO THE EAGLE VALLEY GROUNDWATER BASIN BY AUGMENTED STREAMFLOW IN VICEE CANYON, WESTERN NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-08361

WATER RESOURCES OF MALDIVES,
Ministry of Agriculture, Male (Maldives).
A. H. Ali, and A. M. Mahir.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 83-90.

Descriptors: *Water yield, *Water pollution sources, *Water resources development, *Water quality, *Groundwater pollution, *Domestic water, *Drinking water, *Saline water intrusion, *Water supply development, *Sanitation, *Maldives, *Developing countries, *Rainwater, Desalination plants, Wells, Pumps, Sewer systems, Salinity, Public health, Chlorination, Water tanks, Infiltration, Water distribution, Drawdown, Brackish water.

The freshwater supply of the Republic of Maldives is derived entirely from rainfall. The shallow wells in the sandy soil are the main source of potable water. Since in recent years there has been groundwater pollution caused by infiltration of human and other wastes and by salinity intrusion, people have started to use rooftop rainwater for drinking purposes. Presently, rainwater is stored either as groundwater or as rainwater itself in specially built tanks at public places or in domestic rainwater tanks or other receptacles. In most parts of the Maldives other than the capital island of Male groundwater is almost exclusively for domestic purposes, the water being drawn from individual or community wells. The extensive use of pumps has created a situation of excessive draws-down and the tendency for the wells to turn brackish. This is aggravated by the fact that the groundwater used for toilet flushing ultimately reaches the sea through the present sewer system in Male. The sewers were laid to prevent the pollution of groundwater but ultimately are contributing to the depletion of freshwater and intrusion of salinity. The Maldives Water and Sanitation Authority was created to oversee all activities of water supply and sanitation. Its main functions include implementation of all water supply projects; operation and maintenance of public water supplies in Male; distribution of rain water in Male; chlorination and monitoring of public drinking water wells; implementation of special chlorination programs for all wells public and private during epidemics; advising on water supply and sanitation activities of other organizations and projects; coordinating and overseeing the water supply projects in rural areas; overseeing the implementation of the Male Water Supply and Sewerage Project. This Project involves both the small- and large-scale collection of rainwater, chlorination and distribution schemes,

and the installation of a desalination plant to supplement the rainwater collected and stored in the public rainwater scheme. (See also W89-08899) (Sand-PTT)
W89-08905

3C. Use Of Water Of Impaired Quality

GROWTH OF CHANNEL CATFISH IN SALINE GROUNDWATERS OF THE PECOS VALLEY OF NEW MEXICO,
New Mexico State Univ., Las Cruces. Dept. of Fishery and Wildlife Sciences.
P. R. Turner.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-113963/AS, price codes: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 231, June 1988. 54p, 1 fig, 12 tab, 65 ref. USGS state project 1423611.

Descriptors: *Saline water, *Aquaculture, *Saline groundwater, Catfish, New Mexico, Roswell Test Facility, Pecos Valley.

The essentially unused 18.5 trillion cu m of saline (> 3,000 mg/L) groundwater in New Mexico cannot be readily utilized by conventional water users. However, its use for production of euryhaline species offers potential opportunities in the state because of the rapid growth of aquaculture and increasing demand for fishery products in the United States. The objective of this research was to evaluate the potential use of saline groundwater for culture of channel catfish, a species with high consumer acceptance. Laboratory studies in circular tanks at the Roswell Test Facility indicated that fingerling channel catfish can be grown efficiently in groundwaters with salinities < 6,500 mg/L. Percent weight gain, food conversion, and survival of channel catfish at these salinities were comparable to results of other studies done in fresh water. Further evaluation of the economic feasibility of the culture of channel catfish and other species should be made using specific criteria for potential sites and different production systems. Results of this study indicate there are no biological reasons why saline groundwaters of the Pecos Valley cannot be used for aquaculture purposes. (Turner-NM St U.)
W89-08345

MECHANISMS OF SALT TOLERANCE IN PLANTS RELEVANT TO CLOSED SYSTEM AGRICULTURE IN DESERT ENVIRONMENTS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
G. Cunningham, H. Neufeld, and Y. Goldring.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-113955/AS, price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 230, June 1988. 36p, 12 fig, 10 tab, 7 ref. USGS state project 1423631.

Descriptors: *Salinity, *Salt tolerance, *Closed system agriculture, *Plant growth, Agriculture, Photosynthesis, Arid regions, New Mexico, Sporobolus, Halophytes, Carboxylation, Salt stress.

Closed system agriculture (CSA) in arid regions provides a method for minimizing the disadvantages of arid environments such as limited supplies of fresh water, while making maximal use of the main advantages, including abundant solar radiation and long growing seasons. The greatest advantage can be obtained from CSA if it is combined with the use of the often abundant saline groundwater of many arid zones. The effective use of saline water in CSA requires development of plant varieties that can be productive under saline conditions and take full advantage of the CSA environment. This study is aimed at defining physiological characteristics which might provide easily selected or engineered traits that would lead to enhanced production of C4 plant species under CSA conditions utilizing saline water. The findings indicate that increased carboxylation efficiency with increased salinity is a key physiological trait conferring enhanced productivity to certain species of Sporobolus under saline CSA conditions. This trait can be identified by lowered CO2 concentrations in the intercellular spaces in response to salinity. (Cunningham-NM St U.)
W89-08346

WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA, 1985,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08420

EFFECTS OF TREATED MUNICIPAL EFFLUENT IRRIGATION ON GROUNDWATER BENEATH SPRAYFIELDS, TALLAHASSEE, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-08421

IMPACT OF ORGANIC SUBSTANCES ON MUNICIPAL WASTEWATER REUSE,
For primary bibliographic entry see Field 5D.
W89-08709

IMPACT OF ORGANIC SUBSTANCES ON WASTEWATER RECYCLING IN INDUSTRY,
Camp Dresser and McKee, Inc.
For primary bibliographic entry see Field 5D.
W89-08714

HYDROLOGIC EFFECTS OF ARTIFICIAL-RECHARGE EXPERIMENTS WITH RECLAIMED WATER AT EAST MEADOW, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-09027

3D. Conservation In Domestic and Municipal Use

INNOVATIVE PRICING FOR RESIDENTIAL WATER SUPPLY,
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 6C.
W89-08259

HISTORY OF NEW MEXICO STATE UNIVERSITY'S WELL DEVELOPMENT AND GROUNDWATER USE,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 6D.
W89-08330

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
C. Hughes, R. Narayanan, M. McKee, A. Bishop, and R. LeConte.
Available from National Technical Information Service, Springfield, VA 22161 as PB87-190617/AS, price codes: A08 in paper copy, A01 in microfiche. Completion Report, September 1986. 142p, 42 fig, 40 tab, 44 ref. USGS project 14-08-0001-G1063.

Descriptors: *Water conservation, *Economic evaluation, *Pricing, *Evaluation, *Municipal water, Water supply, Optimization, Model studies, Utah, Pricing, Dual water systems, Imported water, Benefits, Risks, Flow restricting devices.

Five concepts for conservation of municipal water supply were analyzed from an economic efficiency perspective. They include (1) seasonal pricing (for reduction of peak period water use), (2) dual water systems (separate high quality drinking water and untreated outdoor irrigation systems), (3) imported water transmission facility capacity optimization, (4) flow restricting devices, and (5) short-term rationing concepts. Optimization models, including generalized model generators, were developed for analysis of the first three concepts, and model applications to cities in Utah were demonstrated for each. The flow restricting device and short-term rationing concept analyses were based upon approaches taken from the literature but applied to example sites in Utah. The final chapter is a comparison of results and summary of conditions which favor each approach to conservation. Conclusions include: Seasonal pricing was demonstrated to reduce peak period water use but is not justified in Salt Lake City because the added cost of metering exceeds the additional benefits. Dual water systems are potentially an important concept for matching various qualities of water with appropriate uses and producing net economic benefits. Determination of capacity of an imported water facility is dominated more by the decision maker's attitude toward risk than by pricing policy. Flow restricting devices produce economic benefits only if the change in quality of service is ignored. Price elasticity is much lower during a drought than during normal conditions. (USGS)
W89-08449

3F. Conservation In Agriculture

ECONOMIC ANALYSIS OF CONJUCTIVE USE OF WATER: THE CASE OF MAHI-KADANA IRRIGATION PROJECT IN GUJARAT, INDIA,
Illinois Univ. at Urbana-Champaign. Graduate Coll.
S. L. Kolavalli.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8701536. Ph.D. Dissertation, 1986. 153p, 1 fig, 29 tab, 59 ref, 2 append.

Descriptors: *Economic aspects, *Water use, *Farm management, *Well water, *Irrigation canals, *Conjunctive use, Surface irrigation, Furrow irrigation, Productivity, Groundwater irrigation, Irrigation efficiency, Model studies, India.

Empirical models were developed to estimate the conjunctive use of well water, the use of cash inputs, and gross annual production using farm level data. Conjunctive use is hypothesized to be related to the characteristics of canal water supplies. The characteristics are measured by the location of farms in the system and by farmers' satisfaction with canal supplies. Farmers who have poorer supplies are expected to use greater amounts of well water. The use of cash inputs is hypothesized to be related to water control, extent of irrigation, and income from sources other than agriculture. Spending on canal irrigation serves as a proxy for the extent of canal irrigation. The purchase of well water indicates water control. Income from non-farm sources is hypothesized to result in greater use of inputs. Gross production is hypothesized to be related to outlays for canal irrigation, for well water, the use of modern inputs, outlays for tractor and bullock services and labor. All six variables are expected to be positively related to gross production. (Cremmins-AEPCO)
W89-08243

SIMULATION MODEL FOR MANAGING IRRIGATION PROJECTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
E. N. Biggs.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8618165. Ph.D. Dissertation, 1986. 173p, 10 fig, 6 tab, 51 ref, 4 append.

Descriptors: *Computer models, *Model studies, *Simulation analysis, *Management planning, *Irrigation engineering, Irrigation operation, Irrigation design, Irrigation efficiency, Irrigation pro-

grams, Irrigation canals, Evapotranspiration, Groundwater movement.

A computer simulation mode was developed for the management of the technical components and relationships in an irrigation project. The model requires data on a delivery schedule at the upstream point of the canal or project; irrigation diversions, areas and efficiencies; evapotranspiration; groundwater movement; and canal size, length, friction factors, and control structures. It provides a tool for management or engineers to analyze an existing or proposed irrigation system with its accompanying operation criteria and to observe the effects of the design and operation criteria, or changes to them throughout the service area. The model can be applied from a single farm to a medium-size irrigation project. It could be used by farmers to check their operation procedures, managers of irrigation systems to plan changes in their systems and operations, agricultural consultants to analyze irrigation systems and practices, and engineers studying existing and proposed projects. The model provides a simple way to consider 'what if' alternatives and observe the effects throughout an irrigation system. It does this while requiring little computer training and a small basic computer. (Cremmins-AEPCO)
W89-08265

EROSION CONTROL APPARATUS,
Ero-Con, Inc., Eden Prairie, MN.
For primary bibliographic entry see Field 4D.
W89-08287

DRAINING, IRRIGATING AND DISPERSING MASS,
For primary bibliographic entry see Field 4A.
W89-08296

HISTORY OF NEW MEXICO STATE UNIVERSITY'S WELL DEVELOPMENT AND GROUNDWATER USE,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 6D.
W89-08330

POTENTIAL OF SURFACE WATER CONTAMINATION FROM THREE TRIAZINE HERBICIDES,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 5B.
W89-08334

DEVELOPMENT AND DEMONSTRATION OF PUMP STATION AND SURFACE DIVERSION MONITOR SYSTEMS FOR WATER AND ENERGY EFFICIENCY IMPROVEMENTS,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
C. E. Brockway, and C. W. Robison.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115562/AS, price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute Completion Report, Moscow, July 1988. 18p, 5 fig, 5 tab. USGS contract 14-08-0001-G1419. USGS project G1419-05.

Descriptors: *Irrigation, *Pumps, *Open channels, *Monitoring, Flow, Energy, Idaho, Monitors, Pump stations, Electronic sensors, Operations.

Microprocessor based monitoring units for pump station and open channel diversions were developed and installed at eight locations in southern Idaho. Commercial electronic units and sensors were utilized to provide operator accessible data as well as storage of measured and calculated parameters. Pump station monitors measure and record input energy, lift and pumping pressures, discharge, and calculated system efficiency as well as cost/unit volume of water pumped. Open channel diversion monitors utilize float-operated variable potentiometers to record water stage as input to discharge rating curves stored in the processor. Some start-up and operational problems such as battery drain have been corrected and the units provide useful data both for operational evaluation as well as water rights administration. (USGS)
W89-08340

MECHANISMS OF SALT TOLERANCE IN PLANTS RELEVANT TO CLOSED SYSTEM AGRICULTURE IN DESERT ENVIRONMENTS,
New Mexico State Univ., Las Cruces. Dept. of Biology.
For primary bibliographic entry see Field 3C.
W89-08346

ESTIMATES OF CONSUMPTIVE USE AND GROUNDWATER RETURN FLOW USING WATER BUDGETS IN PARKER VALLEY, ARIZONA, AND CALIFORNIA, 1981-84,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08428

APPLICATION OF MULTISPECTRAL SCANNING REMOTE SENSING IN AGRICULTURAL WATER MANAGEMENT PROBLEMS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W89-08575

POTENTIAL OF NUMERICAL AGRONOMIC SIMULATION MODELS,
Centre for World Food Studies, Wageningen-Amsterdam, The Netherlands.
For primary bibliographic entry see Field 7C.
W89-08606

GROUND-WATER YIELD AND POTENTIAL FOR IRRIGATED AGRICULTURE IN THE AREA OF THE NAVAL MAGAZINE AND RADIO TRANSMITTING FACILITY, LUALUALEI, OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08683

FLOOD CONTROL WITH THE USE OF AN IRRIGATION STORAGE RESERVOIR,
Ministry of Public Works, Santiago (Chile). Irrigation Directorate.
E. Kaliski.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 309-323, 6 fig, 4 ref.

Descriptors: *Irrigation programs, *Storage reservoirs, *Flood control, *Multipurpose reservoirs, *Model studies, *Economic aspects, Mathematical studies, Simulation analysis, Storage capacity, Data processing, Flood damage, River beds, Flood waves, Storms, Chile.

A methodology developed to analyze the effect on irrigation of an irrigation reservoir additionally serving flood control purposes. The analysis is basically carried out in economic terms, evaluating the expected net benefit in the longterm operation of a project used for both purposes. The expected benefits from irrigation, owing to the use of a portion of the reservoir's storage volume for flood control, are obtained through a monthly simulation model, incorporating the useful capacity of the reservoir to store irrigation water as variables. The expected benefits from flood control are obtained through a mathematical treatment of a series of land data related to the damage resulting from the inundations caused by floods in various return periods. These inundations are determined according to the characteristics of the reservoir, the river bed, and the flood wave. Subsequently, an application of the methodology to the 'Paloma System' and the results achieved in the 1984 storm in Santiago, Chile are included. (See also W89-08863) (Author's abstract)
W89-08890

MULTI-PURPOSE FLOOD CONTROL AND IRRIGATION RESERVOIR ON A TRIBUTARY OF THE ADIGE RIVER (ITALY),
Padua Univ. (Italy).
For primary bibliographic entry see Field 4A.
W89-08895

WATER RESOURCES DEVELOPMENT IN INDONESIA,
Small Tribes Organization of Western Washington, Sumner.
For primary bibliographic entry see Field 6E.
W89-08903

WATER RESOURCES DEVELOPMENT AND MANAGEMENT IN MALAYSIA,
Drainage and Irrigation Dept., Kuala Lumpur (Malaysia).
For primary bibliographic entry see Field 6E.
W89-08904

WATER RESOURCES DEVELOPMENT IN NEPAL,
Water and Energy Commission, Kathmandu (Nepal).
For primary bibliographic entry see Field 6E.
W89-08906

POLICY FRAMEWORK AND INSTITUTIONS FOR WATER RESOURCES PLANNING, DEVELOPMENT, AND MANAGEMENT IN PAKISTAN,
Pakistan Water and Power Development Authority, Lahore.
For primary bibliographic entry see Field 6B.
W89-08907

WATER RESOURCES UTILIZATION FOR AGRICULTURE IN THAILAND,
Royal Irrigation Dept., Bangkok (Thailand).
For primary bibliographic entry see Field 6D.
W89-08909

WATER RESOURCES DEVELOPMENT IN BANGLADESH: PROBLEMS AND PROSPECTS,
North West Hydraulic Consultants Ltd., Dacca (Bangladesh).
H. R. Khan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 165-181, 1 fig, 3 tab, 10 ref.

Descriptors: *Crop production, *Irrigation programs, *Water resources development, *Bangladesh, *Developing countries, Flood control, Agriculture, Monsoons, Drought, Flooding, Drainage.

With about 80% of the population of Bangladesh engaged in agriculture, food grain self-sufficiency has emerged as one of the major policy objectives. The overall development program in Bangladesh has been geared toward this objective, with a focus on irrigation investments with immediate impact on the food grain production. This paper discusses the development of irrigation in Bangladesh, and the constraints imposed on the crop production by the alternating monsoon and dry seasons. Also discussed is the problem of flooding and drainage and flood control projects. (See also W89-08899) (Sand-PTT)
W89-08911

AGRO-SOCIO-ECONOMIC CONDITIONS IN BANGLADESH,
Bangladesh Inst. of Development Studies, Dacca.
For primary bibliographic entry see Field 6E.
W89-08912

LAND USE IN BANGLADESH,
Ministry of Food, Dacca (Bangladesh). Food Div.
A. K. M. K. Choudhury.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 203-215, 1 tab, 18 ref.

Descriptors: *Crop production, *Crop yield, *Water resources development, *Bangladesh, *Developing countries, *Land use, *Irrigation, *Drainage, *Flood control, Economic aspects, Urbanization, Industrialization, Planning, Agriculture, Reforestation, Human population, Cultivated lands.

Analysis of data on land use in Bangladesh between 1971 and 1983 indicates that cropping intensity and land use have not improved significantly over this period. Programs for intensive use of agricultural inputs and diversification of cropping systems, including multiple cropping, have produced no noticeable impact on increasing the cropping intensity up to the desired level. Forest land has also declined during this period, despite the government's afforestation and replanting programs. Because there are no significant areas of virgin land to be opened up, increased agricultural production must come from further intensification of cropping and diversification programs. Irrigation, drainage, and flood control schemes have been accorded high priority for achieving self-sufficiency in food grain production and maximizing production of export commodities. With respect to land use in rural areas, the per capita availability of cultivable land is low compared to other developing countries, and the land/man ratio is expected to worsen as the population continues to grow. About 15% of the rural land is presently occupied by homesteads, and it is estimated that by the turn of the century, 30% of the land will be used for homesteads and other nonagricultural purposes, further reducing the cultivable area of the country. There is little control and regulation over land use in the rural areas, most of the land is producing well below its potential, and there is little incentive for sharecroppers to produce more. Introduction and spread of new technology are being hampered due to insecurity of tenure, fragmentation of land holdings, and inadequate supply and services. The demand for land for nonagricultural purposes and urban use has increased sharply due to rapid urbanization and industrialization, and there is presently no effective policy for protecting farmland from encroachment by the urban sector. These problems emphasize the need for a national land use policy to meet the developmental needs of the agricultural section in the rural areas as well as land requirements of cities and towns for nonagricultural purposes in the urban sector. (See also W89-08899) (Sand-PTT)
W89-08913

GROUND WATER POLICIES: OPTIONS AND LAWS IN BANGLADESH,
Ministry of Agriculutre, Dacca (Bangladesh).
For primary bibliographic entry see Field 4B.
W89-08918

WATER USER ORGANIZATIONAL NEEDS AND ALTERNATIVES,
National Irrigation Administration, Quezon City (Philipines).
B. U. Bagadion.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 581-607.

Descriptors: *Water resources development, *Water policy, *Policy making, *Public participation, *Water users, *Planning, *Developing countries, *Irrigation programs, Social aspects, Public relations, Cooperatives, Community development, Irrigation operation, Administrative agencies, Philippines.

In recent years there has been increasing interest in the organization of water users in water resources projects in developing countries. In irrigation systems, unless water users organize and share responsibilities for operating and maintaining the system and adopt improved methods for increasing its production, no satisfactory level of efficiency and productivity can be attained. The experience of the National Irrigation Administration (NIA) in the Philippines shows the importance of policy in organizing and sustaining water users associations. In 1976, after years of unsuccessfully trying to organize farmers, the NIA started pilot projects by fielding community organizers who lived in the farmers' communities and mobilized the farmers to participate in planning, construction, operation, and maintenance of irrigation systems. To make this new program effective, NIA had to develop the capability to respond positively to the farmers' participation as well as adopt policies that foster such participation and strengthen irrigation associations. In irrigation systems covered by this program, irrigation associations have taken responsibilities for the operation and maintenance of irrigation facilities under conditions stipulated in agreements with NIA. These associations are given training in irrigation systems management and financial management. In irrigation systems with these associations, canals are better maintained, irrigation fee collections have increased, and relations between the NIA and the farmers have improved. (See also W89-08899) (Sand-PTT)
W89-08933

IRRIGATION DATA FROM CASTRO AND PARMER COUNTIES, TEXAS, 1983-84,
Geological Survey, Austin, TX. Water Resources Div.
P. L. Rettman, and G. D. McAdoo.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-699, 1986. 36p, 2 fig, 5 tab, 6 ref, append.

Descriptors: *Texas, *Castro County, *Parmer County, *Irrigation-return flow, *Irrigation efficiency, *Irrigation requirements, Hydrologic data, Agriculture, Irrigation practices, Groundwater irrigation, Aquifers, Well yields, Crops, Return flow, Pumpage.

Castro and Parmer Counties, with an estimated 700,000 acres under irrigation, are two of the leading agricultural counties in Texas. Irrigation data collected by the U.S. Geological Survey at 64 randomly selected sites are summarized as part of a study to define better the relationship between pumpage for irrigation and return flow to the High Plains aquifer from applied water (irrigation plus precipitation). The irrigation data include well yields, time of operation, fuel consumption, and water applied to individual crops for the 1983 and 1984 growing seasons. The average water application rate for corn was 35.1 inches in 1983 and 31.5 inches in 1984; the rate for cotton was 12.4 inches in 1983 and 13.7 inches in 1984; and the rate for wheat was 15.5 inches in 1984. (Author's abstract)
W89-09108

COMPARISON OF IRRIGATION PUMPAGE WITH CHANGE IN GROUND-WATER STORAGE IN THE HIGH PLAINS AQUIFER IN CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA, 1975-83,
Geological Survey, Lakewood, CO. Water Resources Div.
F. J. Heimes, C. F. Ferrigno, E. D. Gutentag, R. R. Luckey, and D. M. Stephens.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4044, 1987. 34p, 10 fig, 9 tab, 14 ref.

Descriptors: *Recharge, *Irrigation-return flow, *Groundwater irrigation, *Groundwater budget, *Irrigation practices, *Nebraska, Groundwater depletion, Groundwater storage, Specific yield, Groundwater recharge, Irrigation.

The relation between pumpage and change in storage was evaluated for most of a three-county area in southwestern Nebraska from 1975 through 1983. Initial comparison of the 1975-83 pumpage with change in storage in the study area indicated that the 1,042,300 acre-ft of change in storage was only about 30% of the 3,425,000 acre-ft of pumpage. An evaluation of the data used to calculate pumpage and change in storage indicated that there was a relatively large potential for error in estimates of specific yield. As a result, minimum and maximum values of specific yield were estimated and used to recalculate change in storage. Estimates also were derived for the minimum and maximum amounts of recharge that could occur as a result of cultivation practices. The minimum and maximum estimates for specific yield and for recharge from cultivation practices were used to compute a range of values for the potential amount of additional recharge that occurred as a result of irrigation. The minimum and maximum amounts of recharge that could be caused by irrigation in the study area were 953,200 acre-ft (28% of pumpage) and 2,611,200 acre-ft (76% of pumpage), respectively. These values indicate that a substantial percentage of the water pumped from the aquifer is resupplied to storage in the aquifer as a result of a combination of irrigation return flow and enhanced recharge from precipitation that results from cultivation and irrigation practices. (Author's abstract)
W89-09175

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RISK-ANALYSIS BASED STRATEGY ON MULTI-PURPOSE RESERVOIR SYSTEMS OPERATIONS,
Texas A and M Univ., College Station. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 6A.
W89-08244

MEANS FOR PROVIDING A VERTICAL DRAIN IN SOIL,
M. O. Juhola.
U.S. Patent No. 4,449,848; May 22, 1984, 4p, 3 fig. Official Gazette of the United States Patent Office, Vol 1042, No 4, p 1588, May 22, 1984.

Descriptors: *Patents, *Subsoil drainage, *Drainage systems, *Tubes, Subsoil drains, Dewatering, Vertical flow, Clays, Silt, Soil water.

Prefabricated drains consolidate water-carrying, fine-grained soil with low water permeability, such as clay and silt, by dewatering the soil vertically to reduce the water content. The vertical drain in soil comprises a push tube and a prefabricated drain provided with a plate-like anchor on its lower end. The anchor rests against the lower end of the push tube and, when the push tube is pulled back upwards, keeps the drain in place. The push tube contains at least one pouch-like pressure member between the lower end and the anchor, which can be inflated using a pressurized fluid so that it pushes the anchor off the lower end of the push tube and spreads it out in a fully opened position. Thus, the surface of the anchor that attaches to the adjacent soil becomes substantially larger so that the anchor plate will be positively retained in place when the push tube is pulled up. The bearing capacity of the ground is improved and settlings are accelerated, while the shearing strength of the soil increases. (Cremmins-AEPCO)
W89-08279

OPEN TOP DRAIN,
Bethlehem Steel Corp., PA.
L. N. Lamphier, and W. A. Meyers.
U.S. Patent No. 4,451,172; May 29, 1984, 4p, 9 fig. Official Gazette of the United States Patent Office, Vol 1042, No 5, p2045, May 29, 1984.

Descriptors: *Patents, *Culverts, *Surface drainage, *Pipes, *Drainage systems, Water conveyance, Anchors, Conveyance structures, Paving.

A corrugated metal open top drain pipe collects and removes surface water from highways, parking lots, airports, and the like. A culvert contains a corrugated metal cylindrical wall and longitudinal-

ly spaced and elongated rectangular openings, which are disposed at regular intervals in a line along the top of the culvert for the entry of water. The openings are separated longitudinally by curved portions of the corrugated wall. Each wall portion includes at least one corrugation and a seam. The bottom and sides of the culvert wall are essentially free of openings. Metal bar anchors, having a curved portion extending obliquely across one of the openings and secured to the bottom of the corrugation valley on either side of the opening, contain two end portions projecting upwardly and outwardly away from the outer surface of the culvert wall. (Cremmins-AEPCO)
W89-08285

DRAINING, IRRIGATING AND DISPERSING MASS,
M. L. Minielle, A. H. Mazoin, R. P. Brun, S. V. Chevanne, and J. L. See.
U.S. Patent No. 4,411,555; October 25, 1983, 7p, 14 fig. Official Gazette of the United States Patent Office, Vol 1035, No 4, p1561, October 25, 1983.

Descriptors: *Patents, *Subsurface drainage, *Soil porosity, *Subsoil drainage, *Subsurface irrigation, Soil dispersants, Irrigation practices, Drainage practices, Enrichment, Porous media, Capillary water.

A mass that was constructed for draining, irrigating, or lightening of soils is composed of hollow elements of various sizes, shapes, wall thicknesses, and rigidity. The elements are internally defined through open-ended capillary or semi-capillary passages. The mass is also composed of soil in which the hollow elements are dispersed in mutual contact. The elements are oriented so as to provide spaces of various shapes and dimensions between adjacent elements to form a porous mass. Some of the elements comprise two hollow hemispheres and a system for joining the hemispheres to form hollow spheres. (Cremmins-AEPCO)
W89-08296

DRAINAGE TUBE,
A.A.R.C. (Management) Pty. Limited, Victoria (Australia). (Assignee).
A. E. Flecknoe-Brown.
U.S. Patent No. 4,639,165; January 27, 1986, 11p, 7 fig, 2 tab. Official Gazette of the United States Patent Office, Vol 1074, No 4, p2045, January 27, 1986.

Descriptors: *Patents, *Subsoil drainage, *Drainage systems, *Trenches, Soil water, Wastewater management, Water transport, Filter media.

A continuous subsoil strip or sheet drainage element is used in trench drain systems for removing water from soil in agriculture, road building, and construction, and in distributing wastewater into drainage, irrigation, or leach fields. The drainage element comprises an internal supporting thermoplastic core strip or sheet of generally planar configuration. Upon the strip or sheet is disposed on at least one side of the base plane, regularly spaced, hollow, equal depth tapered supporting projections having generally flat tops. The core is covered on all four sides with a flexible geotextile filter cloth. The cloth is not attached to the projections on the core and is free to move with respect to the projections. The relative depth and spacing of the projections acts to restrain the filter cloth against being forced into the hollow interiors of the projections. The depth of the projections is preferably greater than one quarter of their closest spacing and the average diameter of their flat tops may be greater than 0.2 and less than 0.35 of their closest spacing. (Cremmins-AEPCO)
W89-08301

METHOD AND APPARATUS FOR LAYING DRAINS IN FROST-SUSCEPTIBLE GROUND, AND DRAINS LAID IN SUCH GROUND,
O. S. Arntyr, and T. I. Engstrom.
U.S. Patent No. 4,553,876; November 19, 1985, 7p, 7 fig. Official Gazette of the United States Patent Office, Vol 1060, No 3, p1211, November 19, 1985.

Descriptors: *Patents, *Surface drainage, *Drainage systems, *Frost, *Pipes, Drainage engineering, Freezing, Thawing.

Surface water drains and manholes are installed in ground that is susceptible to frost using a drain cover at the ground surface, a drain bottom, and one or more drain pipes extending from the cover to the drain bottom. The drain bottom is initially positioned within the ground below the frost line. A long upper drain pipe having a slightly conical outer form is placed in the ground, with the pipe turned with its widest end downwards. The end of the conical pipe is inserted into a socket in the drain bottom to form a telescopic joint between the bottom of the pipe and the socket, while providing a guard over the joint to accept the movement between the pipe and underlying stationary drain bottom. The conicity of the pipe is small enough to prevent the pipe from engaging in the rising movement of the surrounding ground, owing to the frost. The conicity also facilitates the return of the pipe when the ground thaws. (Cremmins-AEPCO)
W89-08302

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08362

METHODS TO DETERMINE TRANSIT LOSSES FOR RETURN FLOWS OF TRANSMOUNTAIN WATER IN FOUNTAIN CREEK BETWEEN COLORADO SPRINGS AND THE ARKANSAS RIVER, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08412

FLOODFLOW CHARACTERISTICS OF WYOMING STREAMS-A COMPILATION OF PREVIOUS INVESTIGATIONS,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08450

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08458

SPECIAL FLOOD HAZARD EVALUATION REPORT: MAUMEE RIVER, HENRY COUNTY, OHIO.
Army Engineer District, Buffalo, NY.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A187 602. Price codes: A03 in paper copy, A01 in microfiche. Army Corps of Engineers, Buffalo District, September 1987. 37p, 1 fig, 2 tab, 2 plates.

Descriptors: *Flood hazard, *Flood profiles, *Rivers, *Flood plain management, *Ohio, Flood plains, Floodways, Land use, Maumee River, Flood forecasting, Floods.

This Special Flood Hazard Evaluation Report, prepared at the request of the Ohio Department of Natural Resources, investigates the potential flood situation along the Maumee River for its entire length in Henry County, with the exception of the city of Napoleon, which has previously been studied under the National Flood Insurance Program. Most of the area along the river in Henry County is predominately rural with the only city being Napoleon. Knowledge of potential floods and flood hazards is important in land use planning. This report includes a history of flooding along the Maumee River and identifies those areas that are subject to possible future floods. Special emphasis is given to those floods through the use of maps and water surface profiles. While the report does not provide solutions to flood problems, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby and reduce flood damages which might be embodied in an overall Flood Plain Management program. Other types of studies, such as those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings, would also profit from this information. (Lantz-PTT)
W89-08535

BUFFALO METROPOLITAN AREA, NY, ERIE COUNTY ALONG LAKE ERIE AND NIAGARA RIVER--SHORELINE PROTECTION INTERIM RECONNAISSANCE REPORT.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 2H.
W89-08553

ALGAE AS WEEDS: ECONOMIC IMPACT, ECOLOGY, AND MANAGEMENT ALTERNATIVES,
Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology.
C. A. Lembi, S. W. O'Neal, and D. F. Spencer.
IN: Algae and Human Affairs. Cambridge University Press, New York. 1988. p 455-481, 1 fig, 136 ref.

Descriptors: *Algal control, *Algae, *Aquatic weeds, *Aquatic productivity, Algal growth, Aquatic plants, Nuisance algae, Economic aspects, Algicides, Eutrophication, Algae harvesting.

The two major growth forms of freshwater macrophytic algae are filamentous mat formers and charoids. The economic impact of weedy algae is virtually impossible to quantify. However, macrophytic algae restrict and greatly reduce the efficiency of culture and harvest activities in fish culture ponds, impair aquatic recreational activities, cause oxygen depletion, and clog rivers, canals and drainage facilities. Very little is known of the impact, either positive or negative, of macrophytic algae on natural aquatic systems. Little information is available on the extent and distribution of aquatic weeds because few studies have been conducted and filamentous algae are seldom differentiated from vascular plants in the studies that are done. Attempts at control have not been highly successful. Alteration of environmental conditions regulating growth remains the most effective method for reducing algal growth. Of the algicides available only copper sulfate can be used selectively for algae, and it has a relatively short persistence time in water. Other control techniques include harvesting and biological controls. (See also W89-08612) (White-Reimer-PTT)
W89-08617

ESTIMATES OF STREAMFLOW CHARACTERISTICS FOR SELECTED SMALL STREAMS, BAKER RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08624

FLOODS IN KANSAS AND TECHNIQUES FOR ESTIMATING THEIR MAGNITUDE AND FREQUENCY ON UNREGULATED STREAMS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08625

TRANSIT LOSSES AND TRAVELTIMES FOR RESERVOIR RELEASES DURING DROUGHT CONDITIONS ALONG THE NEOSHO RIVER FROM COUNCIL GROVE LAKE TO IOLA, EAST-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Re-

sources Div.
For primary bibliographic entry see Field 2E.
W89-08768

REGIONALIZATION OF LOW-FLOW CHARACTERISTICS OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08813

FLOOD OF DECEMBER 1982 AND THE 100- AND 500-YEAR FLOOD ON THE BUFFALO RIVER, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
B. L. Neely.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4192, 1985. 37p, 26 fig, 2 tab, 4 ref.

Descriptors: *Arkansas, *Maximum probable floods, *Buffalo River, *Flood profiles, *Flood peak, *Flood stages, Floods, Hydrographs, Flow duration.

Flood profiles, peak discharges, and stages were determined for the December 1982, the 100-year, and the 500-year floods at 17 sites along the Buffalo River, Arkansas. Typical synthetic stage hydrographs for the 100- and 500-year floods were determined for each site. Flow duration data for gaging stations at St. Joe and Rush are shown. The average velocity of the water for the 100- and 500-year floods is shown for each site. Approximate flood boundaries delineating the 100- and 500-year floods are shown for Ponca, Steel Creek, Pruitt, St. Joe, and Buffalo Point. (Author's abstract)
W89-08814

FLOOD OF OCTOBER 1983 IN SOUTHEASTERN ARIZONA-AREAS OF INUNDATION IN SELECTED REACHES ALONG THE GILA RIVER,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08815

FLOOD HYDROLOGY: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON FLOOD FREQUENCY AND RISK ANALYSES, 14-17 MAY 1986, LOUISIANA STATE UNIVERSITY, BATON ROUGE, U.S.A.
For primary bibliographic entry see Field 10C.
W89-08863

FUTURE FLOOD RESEARCH AGENDA FOR THE UNITED STATES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 6F.
W89-08865

UK FLOOD STUDIES REPORT: CONTINUING RESPONSIBILITIES AND RESEARCH NEEDS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7C.
W89-08866

FLOOD MANAGEMENT IN THE NETHERLANDS FROM THE MIDDLE AGES TO THE SPACE ERA,
Rijkswaterstaat, The Hague (Netherlands).
J. W. van der Made.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 271-280, 6 fig, 2 tab, 6 ref.

Descriptors: *Hydrologic systems, *Flood forecasting, *Flood control, *Storm surges, Netherlands, *Flooding, *Rivers, *Coastal waters, Model studies, River systems, Coasts, Information systems, History.

After a general description of hydrological conditions in the Netherlands, with special reference to the threat of flooding from either the rivers or the sea, a historical review is given of the forecasting procedures for river floods and for storm surges. The present situation is described, highlighting the organization of the information and warning services and the methods used to assess forecasts. Finally, a brief look is taken at possible future developments of modelling and observation techniques. (See also W89-08863) (Author's abstract)
W89-08886

OPTIMIZING FLOOD PROTECTION FOR CYPRESS CREEK, HARRIS COUNTY, TEXAS,
Army Engineer District, Galveston, TX.
P. C. Wilson, and R. Pudlewski.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 281-287, 2 fig, 3 tab, 7 ref.

Descriptors: *Flood protection, *Flood damage, *Texas, *Watershed management, Flood frequency, Flood channels, Storms, Planning, Runoff, River basins, Hydrologic models, Discharge frequency, Optimization, Interagency cooperation, Flood recurrence interval, Channel improvement.

The formulation of a flood damage reduction project is described for Cypress Creek in the San Jacinto River Basin in Harris County, Texas, U.S.A. The investigation was conducted in accordance with the planning guidance and hydrologic study guidelines of the U.S. Water Resources Council and the National Weather Service, supplemented by instructions and regulations of the U.S. Army Corps of Engineers. In developing the discharge-frequency curve, the computed Probable Maximum Storm discharge of 3,115 cubic meters/second was arbitrarily assigned a return frequency of once in 10,000 years. The optimum plan is an improved channel to carry 40-year frequency flood flows under 1990 conditions of watershed development. This level of flood protection is expected to degrade over time, unless county officials are successful in their efforts to control future runoff to the creek. (See also W89-08863) (Author's abstract)
W89-08887

EFFECT OF EMBANKING ON RIVER AND SEA FLOODS,
International Inst. of Hydraulic and Environmental Engineering, Delft (Netherlands).
A. Volker.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 289-297, 2 fig, 3 ref.

Descriptors: *Flood protection, *Tidal floods, *Model studies, *Rivers, *Embankments, *Floods, *Tidal rivers, Coastal zone management, Hydraulic models, Morphology, Water management, Flood peak, Flash floods, Mathematical models, Expenditures, Morphology, Cropland, River beds, Bank erosion, Tidal marshes, Tidal currents, Dams, Drainage, Storm surges, Hydrological regimes.

The effects of embanking on floods in the nontidal reach of a river, as well as in the tidal reach, is described. These effects, often called 'side effects,' are of various kinds: hydraulic effects, morphological effects, and effects on the water management of the land areas. In the nontidal reach the hydraulic effect, most pronounced in the case of flash floods with sharp peaks, generally consists of a rise in the maximum flood levels. Before the introduction of physical and mathematical models, the hydraulic effects of embanking were difficult to evaluate, and unexpected difficulties occurred after construction. Nowadays reliable predictions can be made but the costs of the models, including the extensive data collection, are high. In order to justify these expenses, preliminary estimates are required, showing the order of magnitude of the hydraulic effects, for which only a few data are needed. Other side effects of embanking are: river morphology, water management, cropping patterns, and sanitary conditions. The most important effect on river morphology is a possible rise in the river bed, causing a rise in the flood levels in addition to the hydraulic effect. Furthermore, embanking may entail increased meandering of the river and increased bank erosion. In the tidal reach, embanking of tidal marshes which are exposed to flooding during the tidal cycle involves a reduction of the tidal volumes. The tidal currents which govern the morphology of the tidal creeks decrease and silting-up may occur. This reduces the possibility of tidal gravity drainage. Enclosure of tidal embayments and estuaries may also modify the tides outside the enclosing dam. Under certain conditions the reduction of the area of the basin exposed to flooding during storms leads to a rise in the storm surge levels. Whereas at present the hydraulic effects of embanking can be predicted well, provided that adequate data is available on the original hydrologic regime, it is still much more difficult to make a quantitative prediction of the morphologic effects. (See also W89-08863) (Author's abstract)
W89-08888

MODEL FOR THE OPERATION OF SPILLWAY GATES IN PLUVIAL FLOODS,
Ministry of Public Works, Santiago (Chile). Irrigation Directorate.
L. Arrau.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 299-308, 3 fig, 4 ref.

Descriptors: *Model studies, *Flood control, *Reservoir operation, *Spillway gates, *Flood forecasting, *Hydrologic systems, Rainfall, Hydrologic data, Economic aspects, Flood damage, Storage reservoirs, Flood waves, Flow discharge, Water storage, Decision making, Operating policies.

A methodology based on Decision-Making Theory under conditions of uncertainty is developed for the operation of a spillway gate during floods of a pluvial origin. Forecast states are given by an independent flood forecast model with respect to a given rainfall. Two types of uncertainty conditions are described: hydrological conditions based on the forecasts and economic conditions due to the lack of knowledge concerning the actual damages that a given flow may cause downstream of the storage reservoir. These imply making two decisions: one regarding the maximum flow to be made when the flood wave reaches the reservoir. The ultimate goal is to minimize the economic damages caused by the discharged flow plus the damages caused by a deficient operation resulting in a smaller volume of stored water when the flood is over, compared to a normal operation condition. (See also W89-08863) (Author's abstract)
W89-08889

FLOOD CONTROL WITH THE USE OF AN IRRIGATION STORAGE RESERVOIR,
Ministry of Public Works, Santiago (Chile). Irrigation Directorate.
For primary bibliographic entry see Field 3F.
W89-08890

COST-BENEFIT ANALYSIS OF A PROPOSED STORM SURGE BARRIER ON THE RIVER SCHELDT (BELGIUM),
Katholieke Univ. Leuven (Belgium).
J. Berlamont, M. Sas, and P. Van Rompuy.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 333-345, 6 fig, 2 tab, 6 ref.

Descriptors: *Hydraulic structures, *Belgium, *Storm surges, *Flooding, *Simulation analysis, *Flood protection, *Barriers, *River systems,

*Economic aspects, Flood damage, Flood frequency, Gaging stations, Evaluation, Cost-benefit analysis.

At the request of the Belgian government, the University of Leuven carried out a multi-disciplinary evaluation study of the proposed storm surge barrier on the river Scheldt, near Antwerp (Belgium). After assessing the frequency of occurrence of storm surge levels at Antwerp and at any other station along the river, a number of inundation scenarios were simulated to estimate the flooded area, and thus the damage as a function of the return period. It was found that the cost of the storm surge barrier was six to seventeen times higher than its benefit: it only offers a very expensive marginal extra safety. As a consequence of the study, the barrier project has been abandoned. The study has proved that a multi-disciplinary approach is the best way to evaluate flood protection alternatives in a systematic way, within the wide range of socio-economical constraints. (See also W89-08863) (Author's abstract)
W89-08892

FLOOD PLAIN MANAGEMENT: THE NZ EXPERIENCE,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 6F.
W89-08893

STUDY FOR REAL TIME OPERATION OF FOUR FLOOD RESERVOIRS,
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
A. van der Beken, G. L. Vandewiele, J. Marien, I. Terrens, and G. de Schrijver.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 369-378, 2 fig, 2 tab, 9 ref.

Descriptors: *Reservoir operation, *Flood-control storage, *Model studies, *Simulation analysis, *Flood control, *Flood protection, *Reservoirs, River basins, Weirs, Computer models, Flood forecasting, Process control, Automation, Belgium.

A real time flood control project was performed in Belgium. Studies developed for the automatic operation of the Dijle flood reservoir have been extended for a system of four flood reservoirs in the Demer basin, adjacent to the Dijle basin. The goal of the study is to design a fully automatic operation scheme of all weirs of the four reservoirs by using real time forecasts of the different parts of the flow system. But the on-line calculations and tasks of the process-computer in the future real time system can only be formulated in detail when an acceptable strategy for operating these reservoirs has been developed. Evaluation of this control strategy has been made by an extensive computer simulation study of the complete flood protection scheme. (See also W89-08863) (Author's abstract)
W89-08894

MULTI-PURPOSE FLOOD CONTROL AND IRRIGATION RESERVOIR ON A TRIBUTARY OF THE ADIGE RIVER (ITALY),
Padua Univ. (Italy).
P. Mazzalai, and L. Eccher.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 379-388, 6 fig, 3 tab, 6 ref.

Descriptors: *Italy, *Reservoirs, *River systems, *Watershed management, *Dikes, *Multipurpose reservoirs, *Irrigation, *Flood plain management, *Flood control, Flood damage, Flood routing, Alluvial channels, Perched streams, Tributaries, Rivers.

The works of the multi-purpose Valda reservoir on the Avisio River, one of the major tributaries of the Adige River whose watershed is in Italy (the third largest in extent), are briefly described. For at least one third of its length, the Adige River channel is perched, and the possibility of overtopping the dike system creates a high hazard of flooding to very densely populated areas. Flood studies, flood control design criteria, and flood routing in the reservoir itself and along the Adige River are among the major topics presented. (See also W89-08863) (Author's abstract)
W89-08895

CATASTROPHIC FLOOD AND ITS CONTROL IN AUGUST, 1963 ON HAIHE RIVER BASIN OF CHINA,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Water Management.
H. Bou, and L. Ke.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 389-398, 6 fig.

Descriptors: *Disasters, *Flood control, *River basins, *Flood plain management, *Flood damage, *China, Flood frequency, Floodproofing, Political aspects, Economic aspects, Planning, Nonstructural alternative.

The Haihe River is one of the seven main rivers in China. The capital of China, Beijing, and the large industrial city, Tianjin, are all located within this river basin. It is a political, economical, and cultural center of China, and has suffered frequently-occurring flood disasters in the past. The salient features of the catastrophic flood of August, 1963 in this region are described, along with several key measures that were adopted. The experiences and lessons learned in the combined actions of structural and non-structural measures of flood control are also summarized. In the future, this event will have profound significance for the reconsideration of the guidelines and policies of river control, as well as the defensive measures taken to fulfill the goals set by the flood-relief agencies. (See also W89-08863) (Author's abstract)
W89-08896

BRAZILIAN ELECTRIC SECTOR EXPERIENCE IN FLOOD CONTROL,
ELETROBRAS, Rio de Janeiro (Brazil).
A. M. Vieira, P. R. H. Sales, and L. A. L. Barretto.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 409-418, 2 fig, 3 tab, 6 ref.

Descriptors: *Electric power industry, *Reservoir operation, *Flood control, *Multipurpose reservoirs, *Flood-control storage, *Storage reservoirs, *Mathematical models, *Resource allocation, *Streamflow forecasting, Synthetic analysis, Brazil, Comparison studies, Performance evaluation.

A report of the Brazilian experience in flood control problem analyses by the determination and allocation of flood control space in its reservoirs is presented. The volume times duration curve method of flood control space determination is still the current solution for the problem. New methodologies were tried in order to avoid allocation difficulties in the use of this method; the method gives only the maximum flood control storage for the wet season and a constant allocation of this storage could promote a higher energy deficit risk. The surplus volumes method, also presented, is an alternative for the flood control storage evaluation which, however, does not overcome the allocation question. Another alternative is the critical trajectories method which is an extension of the surplus volumes method. This method solves the problem of allocation by indicating the flood control storage variation through the rainy period. However, it demands synthetic daily mean streamflow series. The results obtained by the three methods for the Sobradinho Reservoir (34.116 cubic kilometers) on the Sao Francisco River in the northeastern region of the country are compared. (See also W89-08863) (Author's abstract)
W89-08898

LAND USE IN BANGLADESH,
Ministry of Food, Dacca (Bangladesh). Food Div.
For primary bibliographic entry see Field 3F.
W89-08913

MEKONG PROJECT: AN EXERCISE IN REGIONAL COOPERATION TO DEVELOP THE LOWER MEKONG BASIN,
Mekong Committee, Bangkok (Thailand).
P. Chomchai.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 497-508, 4 ref.

Descriptors: *Water resources development, *River basin development, *Regional development, *Mekong River, *International commissions, *Planning, Administrative agencies, Southeast Asia, Watershed management, Water supply development, Navigation, Aquaculture, Hydroelectric power, Flood control, Crop production, Hydrologic data collections.

To exploit the vast water resources potential of the lower Mekong basin, the Mekong Committee was established in 1957 by the four riparian governments concerned. The goal of the committee is the comprehensive development of the water resources and related resources of the drainage, including navigation improvement, watershed management, water supply, aquaculture, hydroelectric power, irrigation, flood control, and self-sufficiency in food production. Before the establishment of the committee, three main obstacles - lack of basic data, absence of an appropriate institutional framework, and shortage of funds - had impeded development of the resources of the Mekong river and its tributaries. A lack of basic data needed for the evaluation of the basin's resource potential and its long-term development planning has been largely overcome by over 25 years of data collection. Apart from providing support through the services of international experts and consultants, the committee has also supplied a framework for the equitable sharing of the resources of the river. To obtain substantial investment for the development of the water resources of the basin, the committee has been in touch with, and has had the support of, the international community in its effort to formulate detailed and comprehensive project proposals and seek support from donors in implementing them. Training in the context of the committee's work has been aimed at enhancing the absorptive capacity of member countries and at facilitating the transfer of modern technology in disciplines related to water resources development. (See also W89-08899) (Sand-PTT)
W89-08928

4B. Groundwater Management

ECONOMIC ANALYSIS OF CONJUCTIVE USE OF WATER: THE CASE OF MAHI-KADANA IRRIGATION PROJECT IN GUJARAT, INDIA,
Illinois Univ. at Urbana-Champaign. Graduate Coll.
For primary bibliographic entry see Field 3F.
W89-08243

TWO-DIMENSIONAL FINITE-ELEMENT PROGRAMS FOR WATER FLOW AND WATER QUALITY IN MULTI-AQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2F.
W89-08257

HYDROLOGICAL INVERSE PROBLEM: RECONSIDERATION AND APPLICATION TO THE MICROCOMPUTER,
Florida State Univ., Tallahassee. Dept. of Geology.

For primary bibliographic entry see Field 2F.
W89-08261

POLITICAL ECONOMY OF NATURAL RESOURCES: WATER SCARCITY IN THE HIGH PLAINS REGION OF THE U.S.,
Columbia Univ., New York. Graduate School of Arts and Sciences.
W. M. Jones.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8610773. Ph.D. Dissertation, 1986. 343p, 11 fig, 13 tab, 320 ref, append.

Descriptors: *Political aspects, *Economic aspects, *Water scarcity, *Groundwater depletion, *Ogallala aquifer, *Groundwater mining, Political constraints, Economic impact, Groundwater irrigation, Groundwater inventory, Grain crops, Crop yield, Groundwater management, Public policy.

A political economic assessment of water depletion is based on a case study of the High Plains region (Texas, New Mexico, Oklahoma, Nebraska, and Kansas) and the declining groundwater in the Ogallala Aquifer. It is hypothesized that exhaustion of groundwater supplies in the aquifer results from: (1) the integration of High Plains agriculture into a global economy and the dependence created by agricultural specialization of a single crop economy; (2) federal policies that have supported an agricultural export economy to increase trade revenue; (3) the structure of the international grain market, which vests control of trade in corporations having little national allegiance and a tremendous influence over grain distribution and price; (4) the institutional vulnerability of the High Plains farmers, who are subject to the volatility of the international market and are unable to control grain prices though costs continue to soar; and (5) the structural impediments that have prevented public policy from reversing the water mining trend. Public policies embodied in the legislative and legal apparatus have encouraged the overdraft of the Ogallala Aquifer. (Cremmins-AEPCO)
W89-08262

WATER RESOURCES AND PROVISION PROBLEMS OF RIYADH, SAUDI ARABIA: AN ANALYTICAL STUDY,
Oregon Univ., Eugene. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W89-08263

SUMMARY OF WATER DATA FOR THE JANZEN RECHARGE INVESTIGATION, SCOTT COUNTY, KANSAS, 1980-86,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08305

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1988,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08307

PRELIMINARY EVALUATION OF THE GROUNDWATER RESOURCES OF BAINBRIDGE ISLAND, KITSAP COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08313

FIELD STUDY OF EPHEMERAL STREAM INFILTRATION AND RECHARGE,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W89-08341

ASSESSMENT OF GROUNDWATER CONTAMINATION IN THE ALLUVIAL AQUIFER NEAR WEST POINT, KENTUCKY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08355

RECHARGE TO THE EAGLE VALLEY GROUNDWATER BASIN BY AUGMENTED STREAMFLOW IN VICEE CANYON, WESTERN NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. K. Maurer, and J. M. Fischer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4158, 1988. 66p, 10 fig, 7 tab, 16 ref.

Descriptors: *Artificial recharge, *Carson City, *Infiltration, *Streamflow, *Aeration zone, *Nevada, Alluvial fans, Groundwater storage, Pumpage, Water table.

Recharge to groundwater could be increased by adding imported water to natural surface water flow in Vicee Canyon, in Eagle Valley, Nevada, where municipal pumping has caused as much as 50 ft of water level decline since 1972. Measurements of infiltration rates, percolation rates, and hydraulic conductivity indicate that the area could be conducive to artificial recharge from infiltration of augmented streamflow. Runoff creates natural infiltration beds on the floor of Vicee Canyon, but baseflow causes channelization and armoring of the stream channel, reducing infiltration rates from about 4 inches to 1 inch/hour. A water balance of the streamflow in Vicee Canyon indicates that 60 to 70% becomes recharge, and the remainder is lost to evaporation from a nearby gravel pit and evapotranspiration on the canyon floor. Estimates of recharge from measurements in the unsaturated and saturated zones account for about 45% of the total streamflow. Application of a groundwater flow model indicates that at present pumping rates, water levels below Vicee Canyon and at a nearby municipal well may rise about 15-30 ft after 5 years as a result of about 1 cu ft/sec of augmented streamflow infiltration. (USGS)
W89-08361

DIRECT-CURRENT RESISTIVITY DATA FROM 94 SITES IN NORTHEASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08375

IMPACTS OF IRRIGATION ON INSTREAM FLOW QUANTITY: PART I. WISFOM, THE WELL IMPACT ON STREAM FLOW MODEL, AND PART II. AN ANALYTICAL MODEL DETERMINATION OF VOLUME AND RATE OF STREAM DEPLETION BY INTERMITTENTLY PUMPING WELLS,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-08402

WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA, 1985,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08420

ESTIMATED USE OF WATER IN COLORADO, 1985,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08431

VARIABLY SATURATED FLOW BETWEEN STREAMS AND AQUIFERS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2F.
W89-08434

EFFECTS OF AGRICULTURAL IRRIGATION ON WATER RESOURCES IN THE ST. JOSEPH RIVER BASIN, INDIANA, AND IMPLICATIONS FOR AQUIFER YIELD,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08462

PRELIMINARY ASSESSMENT OF POTENTIAL WELL YIELDS AND THE POTENTIAL FOR ARTIFICIAL RECHARGE OF THE ELM AND MIDDLE JAMES AQUIFERS IN THE ABERDEEN AREA, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
P. J. Emmons.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4017, 1987. 33p, 11 fig, 6 tab, 28 ref.

Descriptors: *Aquifer characteristics, *Water resources data, *South Dakota, *Groundwater budget, *Groundwater management, *Well yield, *Artificial recharge, Elm Aquifer, Middle James Aquifer, Aquifers, Geohydrology, Groundwater quality, Sodium, Sulfates, Calcium, Magnesium, Bicarbonates, Chlorides, Groundwater recharge, Hydraulic properties, Infiltration rate.

A complex hydrologic system exists in the glacial drift overlying the bedrock in the Aberdeen, South Dakota, area. The hydrologic system has been subdivided into three aquifers: the Elm, Middle James, and Deep James. These sand-and-gravel outwash aquifers generally are separated from each other by till or other fine-grained sediments. The Elm aquifer is the uppermost and largest of the aquifers and underlies about 204 sq mi of the study area. The maximum altitude of the top of the Elm aquifer is 1,400 ft and the minimum altitude of the bottom is 1,225 ft. The Middle James aquifer underlies about 172 sq mi of the study area. The maximum altitude of the top of the Middle James aquifer is 1,250 ft and the minimum altitude of the bottom is 1,150 ft. The lower-most Deep James aquifer was not evaluated. The quality of the water from the Elm and Middle James aquifer varies considerably throughout the study area. The predominant chemical constituents in the water from the aquifers are sodium and sulfate ions; however, calcium, magnesium, bicarbonate, or chloride may dominate locally. The calculated theoretical total well yield from the Elm and Middle James aquifers ranges from a minimum of 64 cu ft/sec, which may be conservative, to a maximum of 640 cu ft/sec. Based on available data, yields of 100 to 150 cu ft/sec probably can be obtained from properly sited and constructed wells. The feasibility of artificially recharging an aquifer, using the technique of water spreading, depends on the geologic and hydraulic characteristics of the aquifer and of the sediments overlying the aquifer through which the recharge water must percolate. The sites suitable for artificial recharge in the study area were defined as those areas where the average aquifer thickness was > 20 ft and the average thickness of the fine-grained sediments overlying the aquifer was < 10 ft. Using these criteria, about 14 sq mi of the study area are suitable for artificial recharge. Infiltration rates in the study area are estimated to range from 1.3 to 4.3 ft/day. Using an infiltration rate of 2 ft/day, a spreading pond with an area of 0.16 sq mi would be required to artificially recharge at a rate of 100 cu/sec/m. (Author's abstract)
W89-08620

PRELIMINARY ASSESSMENT OF WATER QUALITY AND ITS RELATION TO HYDROGEOLOGY AND LAND USE: POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources

Div.
For primary bibliographic entry see Field 2F.
W89-08622

EPA GROUND WATER HANDBOOK.
For primary bibliographic entry see Field 2F.
W89-08695

PROTECTION OF PUBLIC WATER SUPPLIES FROM GROUND-WATER CONTAMINATION.
For primary bibliographic entry see Field 5G.
W89-08697

SIMULATION OF THE EFFECTS OF MANAGEMENT ALTERNATIVES ON THE STREAM-AQUIFER SYSTEM, SOUTH FORK SOLOMON RIVER VALLEY BETWEEN WEBSTER RESERVOIR AND WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08823

ESTIMATION OF NATURAL GROUNDWATER RECHARGE.
For primary bibliographic entry see Field 2F.
W89-08830

QUANTIFICATION OF GROUNDWATER RECHARGE IN ARID REGIONS: A PRACTICAL VIEW FOR RESOURCE DEVELOPMENT AND MANAGEMENT,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
For primary bibliographic entry see Field 2F.
W89-08850

SELECTED ISSUES OF GROUNDWATER MANAGEMENT,
New Mexico Univ., Albuquerque. School of Law.
A. E. Utton.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 285-311, 74 ref.

Descriptors: *Conjunctive use, *Water resources development, *Groundwater management, *Water law, *Water policy, *Groundwater mining, Drought management, Groundwater pollution, Critical zones, Planned depletion.

The law and institutions for the management and equitable distribution of groundwaters have been slow to develop. This is particularly true of transboundary aquifers. As populations increase and economic development advances, the need to regulate the use of transboundary groundwater increases. This paper selectively discusses three management concepts: the critical zone, planned depletion, and groundwater as a drought reserve. In the design of legal regimes, it may be advisable to be selective in choosing where to direct administrative resources. Rather than regulating all groundwaters, it may be desirable to focus on 'critical zones,' based on considerations such as the extent of overdraft and aquifer exposure to contamination. In arid and semi-arid areas, planned depletion, or mining, may be justified just as in the case of mining other resources. Such depletion should be carefully planned and should take into account the hydrologic, environmental, social, and economic factors that may be involved. Using groundwaters may be important as a drought reserve in times of shortfalls in surface flows. This conjunctive use of surface and groundwaters needs to be carefully thought through in advance in a drought management plan. (See also W89-08899) (Sand-PTT)
W89-08917

GROUND WATER POLICIES: OPTIONS AND LAWS IN BANGLADESH,
Ministry of Agriculutre, Dacca (Bangladesh).
A. M. M. S. Ali.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 313-334, 1 tab, 12 ref.

Descriptors: *Irrigation practices, *Irrigation efficiency, *Water resources development, *Groundwater management, *Water policy, *Water law, *Groundwater mining, *Bangladesh, *Developing countries, Wells, Social aspects, Import, Technology.

In Bangladesh, groundwater management policies in the past were based mainly on a trial-and-error method which relied heavily on import of hardware as the only means for expanded irrigation coverage. Institutional and social aspects of irrigation management were largely ignored. Sale and installation of equipment proceeded at a much faster rater than the building of an institutional framework for management of groundwater resources. The rapid but unplanned expansion of tubewell irrigation has led to adverse hydrological consequences for which adequate legal and administrative interventions had to be made in the mid-eighties. While it is too early to assess the impact of these interventions, there is now a growing consensus in regard to the need for planned and optimum use of groundwater resources, now identified as a scarce resource. The analysis underscores the need for identification of future policy options in the light of past as well as present experiences. These options are: 1. improve, strengthen, and coordinate the use of existing wells in a way that ensures optimum use of a resource which is not identified to be scarce; 2. strengthen the management system, both on the input and output side, to ensure a well-coordinated planning and implementation of resource use at all levels of the administration; 3. establish and install technologically innovative devices to meet the current situation of diminishing level of water; 4. expand, strengthen, and coordinate the irrigation management program to derive a higher return on investment so as to improve the existing low return on investment; 5. appropriate application of the legal provision, to immediately prevent unplanned and indiscriminate exploitation of groundwater resources; 6. administrative policy decision to stop proliferation of agencies for exploitation of groundwater resources for irrigation; 7. administrative policy intervention for project preferences designed to establish and expand the access of the small and marginal farmer to the use of groundwater resources. (See also W89-08899) (Sand-PTT)
W89-08918

INTRODUCTION TO GROUNDWATER HYDRAULICS--A PROGRAMMED TEXT FOR SELF-INSTRUCTION (INTRODUCCION A LA HIDRAULICA DE AGUAS SUBTERRANEAS),
For primary bibliographic entry see Field 8B.
W89-09010

HYDROLOGIC EFFECTS OF ARTIFICIAL-RECHARGE EXPERIMENTS WITH RECLAIMED WATER AT EAST MEADOW, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
B. J. Schneider, H. F. H. Ku, and E. T. Oaksford.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4323, 1987. 79p, 36 fig, 15 tab, 21 ref.

Descriptors: *Tertiary wastewater, *Artificial recharge, *Reclaimed water, *Groundwater recharge, *Long Island, *New York, Sodium, Chemical analysis, Injection wells, Infiltration, Chlorides, Water quality, Water quality standards, Percolation.

Artificial recharge experiments were conducted at East Meadow, Long Island, New York, from October 1982 through January 1984 to evaluate the degree of groundwater mounding and the chemical effects of artificially replenishing the groundwater system with tertiary-treated wastewater. More than 800 million gallons of treated effluent was returned to the upper glacial aquifer through recharge basins and injection wells in the 15-month period. Reclaimed water was provided by the Cedar Creek advanced wastewater treatment facility in Wantagh, 6 miles away. The chlorinated effluent was pumped to the recharge facility, where it was fed to basins by gravity flow and to injection wells by pumps. Observations during the recharge tests indicate that the two most significant factors in limiting the rate of infiltration through the basin floor were the recharge test duration and quality of reclaimed water. Head buildup in the aquifer beneath the basins ranged from 4.3 to 6.7 ft, depending on the quantity and duration of water application. Head buildup near the injection wells within the aquifer ranged from 0.3 to 1.2 ft. Recharge basins provided a more effective means of moving large quantities of reclaimed water into the aquifer than injection wells. Results of 3-day and 176-day ponding tests in two basins indicate that reclaimed water is relatively unchanged chemically by percolation through the unsaturated zone because: (1) the sand and gravel of the upper glacial aquifer is unreactive, (2) the water moves to the water table rapidly, and (3) the water is highly treated before recharge. The quality of water in the aquifer zones affected by recharge improved, on the whole. Groundwater concentrations of nitrate nitrogen and several low molecular weight hydrocarbons, decreased to well within drinking water standards as a direct result of recharge. Sodium and chloride concentrations increased above background levels as a result of recharge but remained well within drinking water standards and the New York State effluent standards established for this groundwater recharge study. (Lantz-PTT)
W89-09027

PROJECTED GROUND-WATER DEVELOPMENT, GROUND-WATER LEVELS, AND STREAM-AQUIFER LEAKAGE IN THE SOUTH FORK SOLOMON RIVER VALLEY BETWEEN WEBSTER RESERVOIR AND WACONDA LAKE, NORTH-CENTRAL KANSAS, 1979-2020,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09036

SIMULATION OF FIVE GROUND-WATER WITHDRAWAL PROJECTIONS FOR THE BLACK MESA AREA, NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09141

AQMAN: LINEAR AND QUADRATIC PROGRAMMING MATRIX GENERATOR USING TWO-DIMENSIONAL GROUND-WATER FLOW SIMULATION FOR AQUIFER MANAGEMENT MODELING,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09183

SIMULATED EFFECTS OF GROUND-WATER MANAGEMENT ALTERNATIVES FOR THE SALINAS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
E. B. Yates.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4066, 1988. 79p, 29 fig, 7 tab, 17 ref.

Descriptors: *Model studies, *Groundwater management, *Simulation analysis, *Salinas Valley, *California, Groundwater movement, Flow profiles, Hydraulic models, Groundwater recharge, Percolation, Water use, Aquifers, Pumpage, Saline water intrusion, Groundwater depletion, Recharge, Irrigation-return flow.

A two-dimensional digital groundwater flow model was developed to analyze the geohydrology of the groundwater basin in the Salinas Valley.

The model was calibrated for steady-state and transient simulations by comparing simulated with measured or estimated inflows, outflows, and water levels for 1970-81. Preliminary estimates of hydraulic properties and some inflows and outflows were adjusted during model calibration. The simulated mean annual water budget for the basin was 559,500 acre-ft/yr each of outflow and inflow. Inflow components consisted of Salinas River recharge (38.3%), percolation of irrigation water (34.0%), small stream and Arroyo Seco recharge (20.9%), seawater intrusion (3.4%), and other sources (3.4%). Outflow components consisted of agricultural pumpage (91.5%), municipal pumpage (4.0%), and riparian phreatophyte evapotranspiration (4.5%). For the steady-state calibration, 70% of the simulated water levels were within 9 ft of measured water levels for 1970-81. A sensitivity analysis determined the overall stability of the model results. The model input variable that probably contributes most to the uncertainty of the results is the quantity of groundwater recharge contributed by irrigation-return flow to the unconfined aquifer. A 15% change in the estimate of this variable causes an 11% change in the simulated river-seepage rate and a 6% change in the simulated seawater intrusion rate. The calibrated model was used to investigate several water resources management alternatives. Projected pumpage increase at a rate of 1%/yr for 20 yr caused declines in mean annual water levels of 10 to 20 ft in some areas and an increase in seawater intrusion from 18,900 to 23,600 acre-ft/yr. Pumpage decreases in the coastal area decreased seawater intrusion more effectively than pumpage decreases farther inland. When pumpage was decreased uniformly throughout the valley, the decrease in seawater intrusion was only one-fourteenth the decrease in pumpage. Simulations indicated that replacement of groundwater pumpage with imported surface water in a 9,000 acre service area near the coast would result in a decrease in seawater intrusion equaling nearly one-half the quantity of imported water. (Author's abstract)
W89-09186

WATER RESOURCES OF SOUTHEASTERN OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09187

COMPARISON OF IRRIGATION PUMPAGE AND CHANGE IN WATER STORAGE OF THE HIGH PLAINS AQUIFER IN CASTRO AND PARMER COUNTIES, TEXAS, 1975-83,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09192

NATIONAL AND REGIONAL TRENDS IN WATER-WELL DRILLING IN THE UNITED STATES, 1964-84,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09250

4C. Effects On Water Of Man's Non-Water Activities

DESCRIPTION AND EVALUATION OF THE EFFECTS OF URBAN AND AGRICULTURAL DEVELOPMENT OF THE SURFICIAL AQUIFER SYSTEM, PALM BEACH COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
W. L. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 88-4056, 1988. 58p, 18 fig, 7 tab, 71 ref.

Descriptors: *Florida, *Aquifer systems, *Water resources development, *Water use, Water analysis, Geologic history, Water table, Geohydrology, Saline water, Hydrologic data.

The surficial aquifer system in Palm Beach County was studied during 1982-85 to determine the effects of increased urban and agricultural development on groundwater levels, flow directions, and quality. The surficial aquifer system and its geologic matrix are divisible into three zones on the bases of relative permeabilities and lithologic characteristics. The two greatest water users in the county, public supply utilities and agricultural irrigators, increased total water withdrawals by 123 and 50%, respectively, during 1970-80. By 1980, 76% of public supply withdrawals were from zones I and II of the surficial aquifer system, whereas groundwater pumpage for irrigation decreased to 9% of the total irrigation water used. Increases in groundwater withdrawals for public supply were greatest in the southeast and central coastal parts of the county and served as an indicator for potential changes of flow directions and water quality in the surficial aquifer system. Residual seawater, emplaced in the aquifer system during the Pleistocene Epoch, is still prevalent in the central and western parts of Palm Beach County where low permeabilities in the geologic matrix have retarded its dilution. Chemical analyses of canal-water and groundwater samples collected in April 1984 were used to evaluate the effects of groundwater/surface water exchange on the quality of water during canal conveyance across the area containing residual seawater. (USGS)
W89-08312

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 1: HYDROGEOLOGY AND WATER QUALITY,
Geological Survey, Albany, NY. Water Resources Div.
E. J. Wexler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS-Water Resources Investigations Report 86-4070, 1988. 52p, 18 fig, 6 tab, 1 plate.

Descriptors: *New York, *Path of pollutants, *Sanitary landfills, *Groundwater movement, *Groundwater pollution, Solute transport, Leachates, Water pollution sources, Plumes.

Hydrogeology and water quality in a 4 sq mi area surrounding the Brookhaven landfill site in the Town of Brookhaven, New York, were studied in 1981-83. The 60-acre sanitary landfill at the site was excavated in highly permeable glacial outwash that forms the upper glacial aquifer and is lined with a polyvinyl chloride membrane. Groundwater beneath the site is under water table conditions and flows southeast at approximately 1.1 ft/day. Samples from wells downgradient indicate that leachate has entered the aquifer despite the liner. A plume 3,700 ft long, 2,400 ft wide, and at least 90 ft thick was delineated based on specific conductance data. Water quality in the Magothy aquifer and in Beaverdam Creek, a groundwater fed stream 2,000 ft southeast of the landfill site, does not appear to be affected. (USGS)
W89-08318

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK. PART 2. SIMULATION OF GROUNDWATER FLOW,
Geological Survey, Albany, NY. Water Resources Div.
E. J. Wexler, and P. E. Maus.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 86-4106. 1988. 44p, 14 fig, 9 tab, 2 plates, 35 ref.

Descriptors: *New York, *Path of pollutants, *Groundwater movement, *Model studies, *Landfills, *Groundwater pollution, FInite-element method, Leachates, Water pollution sources, Long Island.

Data on the hydrogeology of a 26-sq-mi area surrounding the Brookhaven landfill site in central Suffolk County were collected as part of a hydrologic investigation of solute transport from the site. These data were used to develop a steady-state groundwater flow model of the upper glacial (water table) aquifer in the area. The model accounts for the leakage through confining units underlying the aquifer, seepage to streams, recharge from precipitation, and pumpage and redistribution of water. Refined estimates of aquifer and confining-unit properties were obtained through model calibrations. Water table altitudes generated by the calibrated model were used to determine groundwater velocities and probable flow paths in the vicinity of the site under long-term average hydrologic conditions. Groundwater velocities and probable flow paths in the study area were calculated from simulated water table altitudes generated by the calibrated flow model. Groundwater at the center of the site flows southeastward at a velocity of 1.1 ft/d. The report is the second in a three part series describing the hydrologic conditions and groundwater quality, groundwater flow, and solute transport in the vicinity of the Brookhaven landfill. (USGS)
W89-08320

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 3: SIMULATION OF SOLUTE TRANSPORT,
Geological Survey, Albany, NY. Water Resources Div.
E. J. Wexler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water Resources Investigations Report 86-4207, 1988. 46p, 19 fig, 3 tab, 26 ref.

Descriptors: *Path of pollutants, *New York, *Groundwater pollution, *Sanitary landfills, Model studies, Plumes, Leachates, Long Island, Solute transport.

A solute transport model representing a 2.3-sq mi area surrounding and downgradient from a municipal landfill site in the Town of Brookhaven, N.Y. was used to simulate migration of a conservative solute (chloride) in the upper glacial aquifer. Aquifer values used in the model were: hydraulic conductivity, 200 ft/day; effective porosity, 0.30; longitudinal dispersivity, 100 ft; transverse dispersivity, 20 ft. Average concentration of chloride was set at 875.0 mg/L in leachate and 10 mg/L in recharge and in ambient groundwater. Entry of leachate into the aquifer was assumed to have begun in 1977. Chloride concentrations in the simulated plume after 6 years of travel matched reasonably well the chloride data collected in October-December 1982. After 12 years of travel, the simulated plume extended 6,200 ft and was 2,600 ft wide. Maximum predicted concentration at the site boundary was 160 mg/L. Additional simulations were made to test the model's ability to predict the effect of several remedial strategies on the movement of solutes. These included capping the landfill with an impermeable surface, removal of contaminated groundwater through four recovery wells, and a combination of the first two actions. (USGS)
W89-08321

HYDROLOGIC AND MINING DATA FROM AN AREA OF UNDERGROUND COAL MINING IN GARRETT COUNTY, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08333

COAL SPOIL AND GROUNDWATER CHEMICAL DATA FROM TWO COAL MINES; HANNA BASIN AND POWDER RIVER BASIN, WYOMING,
Geological Survey, Reston, VA. Water Resources Div.
L. R. Larson.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-481, (1988). 18p, 1 fig, 6 tab, 10 ref.

Descriptors: *Chemical analysis, *Groundwater, *Spoil banks, Sulfur compounds, X-ray diffraction, Wyoming.

This report presents data describing chemical and mineralogical composition of spoil material and chemical quality of groundwater at two Wyoming mine sites. Samples were collected at the Medicine Bow-Seminoe Number 1 mining area in the Hanna basin and at the Cordero Mine in the Powder River basin. The data collected from these sites, along with similar data from other coal-mining States in the West, will be used to evaluate methods used in predicting post-mining groundwater quality. The data include mineral-composition analyses, paste-extract analyses, and sulfur-forms analyses of coal spoil; chemical analyses of water from batch-mixing experiments; and analyses of water samples collected from wells in the coal aquifers and from wells in the saturated spoil. (USGS)
W89-08386

LAND USE, WATER USE, STREAMFLOW, AND WATER QUALITY CHARACTERISTICS OF THE CHARLOTTE HARBOR INFLOW AREA, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
K. M. Hammett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-472, 1988. 104p, 26 fig, 29 tab, 104 ref.

Descriptors: *Estuaries, *Land use, *Environmental effects, *Water quality, *Groundwater depletion, *Urbanization, Water use, Stream discharge, Population, Time series analysis, Wastewater, Water supply, Charlotte Harbor, Peace River, Myakka River, Caloosahatchee River, Florida.

Charlotte Harbor, a 270-sq-mi estuarine system in west-central Florida, is being subjected to increasing environmental stress by rapid population growth and development. Population in the inflow area may double by 2020, resulting in increased demands for freshwater and increased waste loads. The Myakka, Peace, and Caloosahatchee Rivers are the three major rivers emptying into the harbor. A long-term trend analysis of streamflow data shows a statistically significant decreasing trend for the Peace River stations at Bartow, Zolfo Springs, and Arcadia. There is no significant trend in the Myakka or Caloosahatchee River data. In the Peace River, the decrease in flow may be related to a long-term decline in the potentiometric surface of the underlying Floridan aquifer system. By the year 2020, the increased population will require an additional 75 million gal/day for water supply. An additional 60 million gal/day of wastewater and urban runoff alone will increase by more than 3 tons/day, which is about three times the current (1986) total nitrogen load from the Myakka River. (USGS)
W89-08424

ESTABLISHMENT OF A NATIVE MIDWESTERN WETLAND PLANT COMMUNITY THROUGH RELOCATION OF MARSH TOPSOIL,
Army Engineer District, Chicago, IL.
S. Elston, J. Rogner, G. Wilhelm, and W. Lampa.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 150-156, 1 tab, 2 ref.

Descriptors: *Vegetation establishment, *Ecosystems, *Highway effects, *Wetlands, *Aquatic plants, *Marshes, *Topsoil, *Ecological effects, Water resources development, Revegetation, Dredging, Case studies, Species diversity, Illinois, Roadways, Habitat development.

The establishment of diverse inland wetland plant communities such as wet prairie and sedge meadow using seeds and/or nursery stock is beset by numerous problems outside the scope of this paper. However, initial success in the relocation of two such areas is reported here. The project was part of an overall mitigation plan designed to compensate for wetland impacts resulting from a proposed highway project. Through the process of identifying and evaluating all wetlands along the North-South Tollway in DuPage County, Illinois, three sites were determined to be of regional natural-area importance: Churchill Prairie, Armitage Road wetland, and 75th Street wetland. Churchill Prairie is a 35-acre mesic and wet prairie remnant owned by the Forest Preserve District of DuPage County. The wetland portion of this site is a 17.3-acre seasonally wet prairie. The Armitage Road and 75th Street wetlands are 3.1 and 5.7 acres in size, respectively, and consist of seasonally saturated to seasonally inundated sedge meadow and shallow marsh. Topographically, all three sites are situated in depressions of drainageways that are typical features of the swell and swale terrain of recently glaciated portions of Illinois. These types of prairie wetlands were historically of very high species diversity. These three remnant wetlands, although only 26 acres in aggregate and nearly surrounded by roads and other urban development, contained over 300 species of vascular plants including two state-endangered species. The excavated material was hauled to a prepared site and spread around the perimeter of an excavated area where suitable hydrologic conditions were expected to occur. The appearance during the first season's growth of a large percentage of the species known from the donor sites has made the project something of a success. (See also W89-08555) (Lantz-PTT)
W89-08563

RECLAMATION OF PYRITIC MINE SPOIL USING CONTAMINATED DREDGED MATERIAL,
Morton Arboretum, Lisle, IL.
For primary bibliographic entry see Field 5E.
W89-08564

PRELIMINARY ASSESSMENT OF WATER QUALITY AND ITS RELATION TO HYDROGEOLOGY AND LAND USE: POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08622

GROUND-WATER QUALITY AND GEOCHEMISTRY OF LAS VEGAS VALLEY, CLARK COUNTY, NEVADA, 1981-83: IMPLEMENTATION OF A MONITORING NETWORK,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08632

PRELIMINARY APPRAISAL OF THE EFFECTS OF LAND USE ON WATER QUALITY IN STRATIFIED-DRIFT AQUIFERS IN CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
S. J. Grady, and M. Fisher-Weaver.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4005, 1988. 41p, 7 fig, 4 tab, 5 plates, 50 ref.

Descriptors: *Glacial sediments, *Land use, *Environmental effects, *Aquifers, *Groundwater pollution, *Connecticut, Water quality, Groundwater quality, Urbanization, Agriculture, Water pollution sources, Sulfates, Ammonia, Nitrogen, Specific conductivity, Hydrogen ion concentration, Calcium, Magnesium, Bicarbonate, Chlorides, Barium, Arsenic, Lead, Lithium.

The stratified-drift aquifers that underlie 7.9 sq mi of the Potatuck and 12.7 sq mi of the Pomperaug River valley, CT, consist primarily of sand and gravel deposits up to 150 ft thick. Average horizontal hydraulic conductivity of the stratified drift ranges from 20 to 170 ft/day, and groundwater flows through the aquifers at an average rate of 2 to 3 ft/day. Land use in the study areas is changing from primarily undeveloped or agricultural lands to expanding residential, commercial, and light-industrial uses. Water quality data for 1923-82, that include 127 partial chemical analyses of groundwater samples from 38 wells in the two aquifers, were augmented by sampling during 1985 from 21 new stainless-steel wells for selected major inorganic constituents, trace elements, and organic chemicals. Nonparametric statistical procedures were used to compare the water quality data from four land use areas, for the two sampling periods, and between the two aquifers. Human activities associated with agricultural, residential, and industrial/commercial land uses have affected the quality of water in the stratified-drift aquifers underlying these land use areas. Statistical comparisons of water quality data between land use areas show significant differences, with the apparent relations between land use and groundwater being: (1) Median concentrations of most groundwater constituents are smallest in undeveloped areas; (2) Groundwater in agricultural areas has the largest median sulfate and total ammonia plus organic nitrogen concentrations. Agricultural areas are also characterized by groundwater with significantly greater median specific conductance, noncarbonate hardness, carbon dioxide, and magnesium concentrations relative to undeveloped areas; (3) Median concentrations of most major inorganic constituents, excluding potassium, sulfate, and total ammonia plus organic nitrogen, are greater in groundwater in residential areas than in undeveloped and agricultural areas. (4) Groundwater in industrial/commercial areas has the greatest median specific conductance, pH, carbon dioxide, calcium, magnesium, chloride bicarbonate, dissolved solids, boron, and strontium concentrations. (Author's abstract)
W89-08633

HYDRAULIC AND CHANNEL CHARACTERISTICS OF SELECTED STREAMS IN THE KANTISHNA HILLS AREA, DENALI NATIONAL PARK AND PRESERVE, ALASKA, 1982-84,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08638

STREAMFLOW AND WATER-QUALITY DATA FOR LAKE AND WETLAND INFLOWS AND OUTFLOWS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1981-82,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08663

EVALUATION OF COAL-MINING IMPACTS USING NUMERICAL CLASSIFICATION OF BENTHIC INVERTEBRATE DATA FROM STREAMS DRAINING A HEAVILY MINED BASIN IN EASTERN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
A. D. Bradfield.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4289, 1986. 59p, 14 fig, 22 tab, 25 ref.

Descriptors: *Coal mining, *Ecological effects, *Benthic fauna, *Bioindicators, *Invertebrates, *Smoky Creek, Water quality, Tennessee, Biomass, Population density, Mathematical studies, Species diversity.

Coal-mining impacts on Smoky Creek, eastern Tennessee were evaluated using water quality and benthic invertebrate data. Data from mined sites were also compared with water quality and invertebrate fauna found at Crabapple Branch, an undisturbed stream in a nearby basin. Although differences in water quality constituent concentrations

and physical habitat conditions at sampling sites were apparent, commonly used measures of benthic invertebrate sample data such as number of taxa, sample diversity, number of organisms, and biomass were inadequate for determining differences in stream environments. Clustering algorithms were more useful in determining differences in benthic invertebrate community structure and composition. Normal (collections) and inverse (species) analyses based on presence-absence data of species of Ephemeroptera, Plecoptera, and Tricoptera were compared using constancy, fidelity, and relative abundance of species found at stations with similar fauna. These analyses identified differences in benthic community composition due to seasonal variations in invertebrate life histories. When data from a single season were examined, sites on tributary streams generally clustered separately from sites on Smoky Creek. These analyses compared with differences in water quality, stream size, and substrate characteristics between tributary sites and the more degraded main stem sites, indicated that numerical classification of invertebrate data can provide discharge-independent information useful in rapid evaluations of in-stream environmental conditions. (Author's abstract)
W89-08686

GROUND-WATER MOVEMENT AND EFFECTS OF COAL STRIP MINING ON WATER QUALITY OF HIGH-WALL LAKES AND AQUIFERS IN THE MACON-HUNTSVILLE AREA, NORTH-CENTRAL MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08719

EFFECTS OF LAND USE ON GROUND-WATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08766

HYDROLOGIC MONITORING OF SELECTED STREAMS IN COAL FIELDS OF CENTRAL AND SOUTHERN UTAH-SUMMARY OF DATA COLLECTED, AUGUST 1978-SEPTEMBER 1984,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08772

POTENTIAL EFFECTS OF ANTICIPATED COAL MINING ON SALINITY OF THE PRICE, SAN RAFAEL, AND GREEN RIVERS, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. L. Lindskov.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4019, 1986. 35p, 6 fig, 17 tab, 18 ref.

Descriptors: *Coal mine effects, *Water quality, *Coal mines, *Environmental effects, *Utah, *Salinity, Price River, San Rafael River, Green River, Seasonal variation, Water quality, Streamflow, Dissolved solids, Scofield Reservoir.

The impact of anticipated coal mining in Utah on the salinity of the Price, San Rafael, and Green Rivers is to be addressed in the repermitting of existing mines and permitting of new mines. To determine the potential impacts, mathematical models were developed for the Price and San Rafael River basins. Little impact on the quantity and quality of streamflow is expected for the Price and San Rafael Rivers. The increase in mean monthly flow of the Price River downstream from Scofield Reservoir is projected as 3.5 cu ft/sec, ranging from 1.7% in June to 140% in February. The potential increase in dissolved solids concentration downstream from Scofield Reservoir would range from 10.4% in June and July (from 202 to 223 mg/L) to 97.0% in February (from 202 to 398 mg/L). However, the concentration of the mixture of mine water with the existing flow released from Scofield Reservoir would contain less than 500 mg/L of dissolved solids. At the mouth of the Price River, the potential increase in mean monthly flow is projected as 12.6 cu ft/sec, ranging from 3.7% in May to 37.7% in January. The potential changes in dissolved solids concentration would range from a 20.7% decrease in January (from 3,677 to 2,917 mg/L) to a 1.3% increase in June (from 1,911 to 1,935 mg/L). At the mouth of the San Rafael River, the potential increase in mean monthly flow ranges from 2.9 cu ft/sec in February to 6.7 cu ft/sec in May, with the increase ranging from 0.8% in June to 12.6% in November. The potential changes in dissolved solids concentration would range from a 5.3% decrease in March (from 2,318 to 2,195 mg/L) to a 0.6% increase in May (from 1,649 to 1,659 mg/L). The anticipated mining in the Price and San Rafael River basins is not expected to cause a detectable change in the quantity and quality of streamflow in the Green River. The projected peak increase in flow resulting from discharge from the mines is less than 0.3% of the average flow in the Green River. (Author's abstract)
W89-08774

RELATION OF SEDIMENT AND NUTRIENT LOADS TO WATERSHED CHARACTERISTICS AND LAND USE IN THE OTISCO LAKE BASIN, ONONDAGA COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08777

EFFECTS OF COAL STRIP MINING ON STREAM WATER QUALITY AND BIOLOGY, SOUTHWESTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
L. A. Fuste, and D. F. Meyer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4056, 1987. 124p, 13 fig, 15 tab, 32 ref.

Descriptors: *Coal mine effects, *Water pollution sources, *Environmental effects, *Coal mining, *Ecological effects, *Water quality, *Washington, Calcium, Magnesium, Sodium, Bicarbonate, Dissolved oxygen, Iron, Manganese, Zinc, Copper, Cobalt, Chromium, Benthic fauna, Species diversity, Erosion.

Strip mining for coal in southwestern Washington may be affecting the water quality of streams. To investigate these possible effects, five streams were selected for study of water quality in each of the two coal bearing areas: the Centralia-Chehalis coal district, and Kelso-Castle Rock coal area. In the Centralia-Chehalis coal district, three of the streams have drainage basins in which mines are active. Water in streams that drain unmined basins is typical of western Washington streams and is characterized as a mixed water because calcium, magnesium, sodium, and bicarbonate ions predominate. A change in anionic composition from bicarbonate to sulfate in streams draining mined areas was not sufficient to change the general water composition and thus make the streams acidic. The largest downstream changes in water quality in both mined and unmined drainage basins were observed during summer low-flow conditions, when minimal dilution, increased water temperatures, and low dissolved oxygen concentrations occurred. High dissolved solids were found in the mined drainage basins during this period. High concentrations of iron, manganese, and zinc were present in the bottom sediments of the mined basins. Moderate concentrations of chromium, cobalt, copper, and zinc were also found in the bottom sediments of a few unmined basins. Streams with substrates of gravel-cobble or gravel-coarse sand had the most diverse benthic fauna and a higher number of ubiquitous taxa than streams with sand-silt substrates, which had the most dissimilar fauna. Mayflies, stoneflies, and caddisflies were rare at the site most affected by mining. The erosion potential of a basin appears to be related to the average basin slope and the amount of forested areas. Strip mining for coal in steep basins may lead to massive movements of unconsolidated spoils after vegetal cover is removed if the land disturbed is graded to pre-mining slopes. (Lantz-PTT)
W89-08801

STATISTICAL SUMMARY AND EVALUATION OF THE QUALITY OF SURFACE WATER IN THE COLORADO RIVER BASIN, 1973-82 WATER YEARS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08806

EVALUATION OF THE EFFECTS OF COAL-MINE RECLAMATION ON WATER QUALITY IN BIG FOUR HOLLOW NEAR LAKE HOPE, SOUTHEASTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08820

EFFECTS OF SURFACE COAL MINING AND RECLAMATION ON GROUND WATER IN SMALL WATERSHEDS IN THE ALLEGHENY PLATEAU, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08825

MODELLING FLUVIAL PROCESSES IN STREAMS WITH GRAVEL MINING,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 977-988, 7 fig, 6 ref.

Descriptors: *Sediment transport, *Stream profiles, *Streamflow, *Gravel mining, *Gravel, *Streamflow forecasting, *River flow, *Mathematical models, *Channel morphology, San Juan Creek, California, Streambed, River bed, Alluvial rivers, Channel erosion, Stream erosion, Mining, Borrow pits, Deposition, Scour, Stream power.

The mathematical model used to evaluate stream channel changes induced by gravel mining employs the concept that an alluvial stream is constantly seeking to establish equal power expenditure per unit channel length, in addition to the ordinary physical relations governing the flow and sediment transport processes. If the energy gradient is approximated by the water surface slope, then uniform power expenditure is equivalent to a straight water surface profile. Therefore, channel width adjustment is such that the water surface profile approaches a straight line subject to the physical constraints. The progressive stream channel changes induced by gravel mining in San Juan Creek included headward erosion, downstream erosion, gravel pit deposition and gradual establishment of a continuous stream bed profile. Throughout these processes, the scour and fill of the channel bed were accompanied by changes in channel width. During the initial stage of headward erosion and deposition in the pit at the stream mouth, the channel developed significant variation in width. The part formed by headward erosion was shaped like a gully which was followed by rapid widening into the pit. Subsequently, the narrow gully was gradually refilled, its width was concurrently increased, and the spatial variation in channel width was progressively reduced. This type of time and spatial variations in width, whether they are in the direction of spatial uniformity or non-uniformity, were consistent with the channel's tendency to seek equal streampower expenditure per unit channel length, that is a straight water surface profile, along the channel. (See also W89-08934) (White-Reimer-PTT)
W89-08966

GROUND-WATER-SURFACE WATER RELATIONS IN THE FLATHEAD RIVER VALLEY NEAR THE PROPOSED CABIN CREEK COAL MINE, BRITISH COLUMBIA, CANADA,
Geological Survey, Helena, MT. Water Resources Div.
J. A. Moreland, H. Liebscher, W. A. Van Voast, and R. D. Feltis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-28, January 1987. 20p, 2 fig, 3 tab, 5 ref.

Descriptors: *Coal mine effects, *Surface-groundwater relations, *Coal mining, *Flathead River, *British Columbia, *Canada, Water quality, Streamflow, Flow profiles, Springs, Groundwater quality, Bedrock, Geohydrology, Calcium, Magnesium, Alkalinity, Groundwater movement.

The area of the proposed Cabin Creek coal mine was studied to obtain information needed to respond to questions posed by the International Joint Commission advisers concerning water resources near the international border. Specific interest focused on determining the extent and character of surficial material in the Flathead River valley, identifying gaining and losing reaches of the river and major tributaries, and documenting ambient water quality at selected sites. Thickness of the alluvial deposits depends on depth to underlaying Quaternary glacial deposits or Tertiary bedrock. The alluvial deposits in the Flathead River valley thin to a veneer of cobbles near the mouth of Couldrey Creek. Measurements of streamflow at 20 sites in the Flathead River valley indicate that water discharges from the alluvial deposits to most of the tributaries and to the river near the proposed mine. The Flathead River gains 0.87 cu m/sec (31 cu ft/sec) of flow near Howell Creek. The Flathead River and Couldrey Creek gained about 0.81 cu m/sec (28.5 cu ft/sec) of flow near the mouth of Couldrey Creek where bedrock crops out in the streambeds. Bedrock outcrops effectively interrupt the alluvial aquifer system between the proposed mine site and the international border. The Flathead River lost 0.87 cu m/sec (31 cu ft/sec) of flow between the bedrock outcrops and the international border; this streamflow loss enters alluvial deposits and flows across the international border as subsurface flow. Analysis of samples from 18 stream sites and 1 spring site indicates general trends in water quality. In Howell Creek, concentrations of calcium, magnesium, and sulfates increased slightly downstream. Conversely, samples from Sage and Couldrey Creeks indicate downstream increases in concentrations of calcium, magnesium, and alkalinity, but decreases in concentrations of sulfate. Water quality of Cabin Creek was relatively stable through the sampled reach. Decreased concentrations of calcium and alkalinity in the Flathead River reflect the effect of inflow from Couldrey Creek and the groundwater inflow documented by streamflow measurements. (Author's abstract)
W89-08982

DESCRIPTION OF THE PHYSICAL ENVIRONMENT AND COAL-MINING HISTORY OF WEST-CENTRAL INDIANA, WITH EMPHASIS ON SIX SMALL WATERSHEDS,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-08987

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09001

HYDROLOGIC CONDITIONS IN THE KLATT BOG AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Glass.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4330, 1986. 19p, 8 fig, 4 tab, 9 ref.

Descriptors: *Bogs, *Hydrologic budget, *Klatt Bog, *Alaska, *Wetlands, Precipitation, Rainfall-runoff relationships, Evapotranspiration, Groundwater recharge, Runoff, Peat bogs, Aquifers, Groundwater recharge, Permeability, Iron, Seasonal variations, Water table.

Klatt Bog is a 2.3 sq mi wetland in Anchorage, Alaska which provides habitat for many wildlife species but also offers potential sites for residential, commercial, and agricultural developments. Precipitation, the main source of water for the area, averages 15 in/yr; during the 1983 study period, precipitation was 12.16 inches. Estimates of evapotranspiration, considered to be the major component of water outflow, range from 10 to 20 inches. Surface runoff and groundwater outflow during 1983 are estimated to be 2.8 and < 0.2 inches, respectively. During summer, most of the runoff is derived from groundwater discharge near the upgradient eastern edge of the wetland. The wetland's aquifer system is composed of fibrous peat which overlies a poorly permeable layer of silt and clay. The aquifer is recharged by infiltration of precipitation and inflow of groundwater from upland areas east of the wetland. During 1983 the water table was at or within 3 ft of land surface in most areas and its seasonal fluctuation was < 2 feet. Water collected from four shallow observation wells, two ponds, and two sites on a stream had concentrations of dissolved iron ranging from 2,300 to 6,100 micrograms/L. (Author's abstract)
W89-09033

HYDROGEOCHEMISTRY OF THE UPPER PART OF THE FORT UNION GROUP IN THE GASCOYNE LIGNITE STRIP-MINING AREA, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09043

SELECTED HYDROLOGIC DATA, KOLOB-ALTON-KAIPAROWITS COAL-FIELDS AREA, SOUTH-CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09070

HYDROLOGIC DATA FOR THE DRAINAGE BASINS OF CHATFIELD AND CHERRY CREEK LAKES, DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09077

HYDROLOGIC AND GEOCHEMICAL DATA FOR THE BIG BROWN LIGNITE MINE AREA, FREESTONE COUNTY, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09091

SEDIMENTATION AND WATER QUALITY IN THE WEST BRANCH SHADE RIVER BASIN, OHIO, 1984 WATER YEAR,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09099

CHEMICAL QUALITY OF GROUND WATER IN SALT LAKE VALLEY, UTAH, 1969-85,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09138

CUMULATIVE POTENTIAL HYDROLOGIC IMPACTS OF SURFACE COAL MINING IN THE EASTERN POWDER RIVER STRUCTURAL BASIN, NORTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. J. Martin, D. L. Naftz, H. W. Lowham, and J. G. Rankl.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4046, 1988. 201p, 52 fig, 33 tab, 5 plates, 118 ref.

Descriptors: *Coal mining, *Groundwater quality, *Powder River, *Environmental effects, *Wyoming, Dissolved solids, Aquifers, Model studies.

There are 16 existing and six proposed surface coal mines in the eastern Powder River structural basin of northeastern Wyoming. Coal mining companies predict water level declines of 5 ft or more in the Wasatch aquifer to extend form about 1,000 to about 2,000 ft beyond the mine pits. The predicted 5 ft water level decline in the Wyodak coal aquifer generally extends 4-8 mi beyond the lease areas. About 3,000 wells are in the area of potential cumulative water level declines resulting from all anticipated mining. Of these 3,000 wells, about 1,200 are outside the areas of anticipated mining: about 1,000 wells supply water for domestic or livestock uses, and about 200 wells supply water for municipal, industrial, irrigation, and miscellaneous uses. The 1,800 remaining wells are used by coal mining companies. Future surface coal mining probably will result in postmining groundwater of similar quality to that currently present in the study area. By use of geochemical modeling techniques, the results of a hypothetical reaction path exercise indicate the potential for marked improvements in postmining water quality because of chemical reactions as postmining groundwater with a large dissolved solids concentration (3,540 mg/L) moves into a coal aquifer with relatively small dissolved solids concentrations (910 mg/L). Results of the modeling exercise also indicate geochemical conditions that are most ideal for large decreases in dissolved solids concentrations in coal aquifers receiving recharge from a spoil aquifer. (Lantz-PTT)
W89-09147

WATER RESOURCES AND POTENTIAL EFFECTS OF SURFACE COAL MINING IN THE AREA OF THE WOODSON PREFERENCE RIGHT LEASE APPLICATION, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
M. R. Cannon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4027, April 1987. 29p, 4 fig, 3 tab, 21 ref.

Descriptors: *Groundwater quality, *Environmental effects, *Coal mining, *Montana, *Geohydrology, Wells, Tongue River, Aquifers, Dissolved solids, Groundwater movement, Streamflow, Leaching, Groundwater pollution.

Federal coal lands of the Woodson Preference Right Lease Application are located in Dawson and Richland Counties, northeastern Montana. A probable mine area, comprised of the lease area and adjacent coal lands, contains about 220 million tons of recoverable lignite coal in the 12-37 ft thick Pust coal bed. A hydrologic study has been conducted in the area to describe the water resources and to evaluate potential effects of coal mining on the water resources. Geohydrologic data collected from wells and springs indicate that several aquifers exist in the area. Sandstone beds in the Tongue River Member of the Fort Union Formation (Paleocene age) are the most common aquifers and probably underlie the entire area. The Pust coal bed in the Tongue River Member is water saturated in part of the probable mine area and is dry in other parts of the probable mine area. Other aquifers, located mostly outside of the probable mine area, exist in gravel of the Flaxville Formation (Miocene of Pliocene age) and valley alluvium (Pleistocene and Holocene age). Chemical analyses

of groundwater indicate a range in dissolved solids concentration of 240-2,280 mg/L. Surface water resources are limited. Most streams in the area are ephemeral and flow only in response to rainfall or snowmelt. Small reaches of the North and Middle Forks of Burns Creek have intermittent flow. Water sampled from a small perennial reach of the Middle Fork had a dissolved solids concentration of 700 mg/L. Mining of the Pust coal bed would destroy one spring and four stock wells, dewater areas of the Pust coal and sandstone aquifers, and probably lower water levels in seven stock and domestic wells. Mining in the valley of Middle Fork Burns Creek would intercept streamflow and alter flow characteristics of a small perennial reach of stream. Leaching of soluble minerals from mine spoils may cause a long-term degradation of the quality of water in the spoils and in aquifers downgradient from the spoils. Some of the effects on local water supplies could be mitigated by development of new wells in deeper sandstones of the Tongue River Member. Effects of mining on water resources would be minimized if only areas of dry coal were mined. (Author's abstract)
W89-09148

FLOODING AND SEDIMENTATION IN WHEELING CREEK BASIN, BELMONT COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09179

APPRAISAL OF STORM-WATER QUALITY NEAR SALEM, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09185

HYDROLOGY OF AREA 58, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09188

HYDROLOGY OF AREA 39, WESTERN REGION, INTERIOR COAL PROVINCE KANSAS AND MISSOURI,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09189

CHANGES IN WATER QUALITY OF MICHIGAN STREAMS NEAR URBAN AREAS, 1973-84,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09193

FINITE-ELEMENT MODEL STUDY OF THE IMPACT OF THE PROPOSED I-326 CROSSING ON FLOOD STAGES OF THE CONGAREE RIVER NEAR COLUMBIA, SOUTH CAROLINA,
Geological Survey, NSTL Station, MS. Water Resources Div.
J. K. Lee, and C. S. Bennett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 81-1194, 1981. 56p, 19 fig, 9 tab, 8 plates, 10 ref.

Descriptors: *Model studies, *Highway effects, *Congaree River, *Flood stages, *Finite element method, *South Carolina, Streamflow, Flood plain, Flood peak, Simulation analysis.

A two-dimensional finite element surface water model was used to study the hydraulic impact of the proposed Interstate Route 326 crossing of the Congaree River near Columbia, SC. The finite element model was assessed as a potential operational tool for analyzing complex highway crossings and other modifications of river flood plains. Infrared aerial photography was used to define regions of homogeneous roughness in the flood plain. Finite element networks approximating flood plain topography were designed using elements of three roughness types. High water marks established during an 8-yr flood that occurred in October 1976 were used to calibrate the model. The maximum flood of record, an approximately 100-yr flood that occurred in August 1908, was modeled in three cases: dikes on the right bank, dikes on the left bank, and dikes on both banks. In each of the three cases, simulations were performed both without and with the proposed highway embankments in place. Detailed information was obtained about backwater effects upstream from the proposed highway embankments, changes in flow distribution resulting from the embankments, and local velocities in the bridge openings. On the basis of results from the model study, the South Carolina Department of Highways and Public Transportation changed the design of several bridge openings. A simulation incorporating the new design for the case with dikes on the left bank indicated that both velocities in the bridge openings and backwater were reduced. A major problem in applying the model was the difficulty in predicting the network detail necessary to avoid local errors caused by roughness discontinuities and large depth gradients. (Lantz-PTT)
W89-09219

SUPPORTING DATA FOR ENVIRONMENTAL TRENDS,
Geological Survey, Reston, VA. Water Resources Div.
D. B. Tunstall.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-534, 1983. 296p.

Descriptors: *Environmental data, *Data collections, *Environmental effects, *Data collections, *Environment, Climate, Wetlands, Social aspects, Land use, Agriculture, Toxicity, Wildlife, Water quality.

Information has been compiled as a companion document to 'Environmental Trends' to provide analysts and researchers with statistical data to understand better how natural and man-made environments were changing. Subjects include land and climate; wetlands; wild areas; historic places; risk zones; settlement patterns; housing units; housing conditions; neighborhood conditions; transportation systems, including use and impacts on the environment such as noise, energy consumption; material use and solid waste; toxic substances, including radiation; cropland, forests and rangeland; wildlife, including extinct, threatened and endangered species; energy; water resources, water quality and air quality; and the biosphere. Statistics in the tables were taken from various published and unpublished sources. Therefore, the number of significant figures for the same information may differ. (Author's abstract)
W89-09227

EFFECTS OF SURFACE COAL MINING AND RECLAMATION ON THE GEOHYDROLOGY OF SIX SMALL WATERSHEDS IN WEST-CENTRAL INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. D. Martin, R. F. Duwelius, and C. G. Crawford.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-210, 1987. 99p, 31 fig, 6 tab, 56 ref.

Descriptors: *Strip mines, *Small watersheds, *Coal mining, *Geohydrology, *Environmental effects, *Indiana, *Land reclamation, Land use, Agriculture, Annual runoff, Groundwater recharge, Surface water, Groundwater, Meteorological data collection, Strip mine lakes, Base flow, Surface-groundwater relations.

The watersheds studied include mined and reclaimed; mined and unreclaimed; and unmined, agricultural land uses, and are each < 3 sq mi in area. Surface water, groundwater, and meteorologic data for the 1981 and 1982 water years were used to describe and compare hydrologic systems of the six watersheds and to identify hydrologic effects of mining and reclamation. Peak discharges were greater at the agricultural watersheds than at the unreclaimed watersheds, primarily because of large final-cut lakes in the unreclaimed watersheds. Annual runoff was greatest at the unreclaimed watersheds, intermediate at the agricultural watersheds, and least at the reclaimed watersheds. Hydrologic effects of mining were identified by comparing the hydrologic systems at mined and unreclaimed watersheds with those at unmined, agricultural watersheds. Comparisons of the hydrologic systems of these watersheds indicate that surface coal mining without reclamation has the potential to increase annual runoff, base flow, and groundwater recharge to the bedrock; reduce peak flow rates and variation in flow; lower the water table in upland areas; change the relation between surface water and groundwater divides; and create numerous, local flow systems in the shallow groundwater. Hydrologic effects of reclamation were identified by comparing the hydrologic systems at mined and reclaimed watersheds with those at mined and unreclaimed watersheds. Reclamation has the potential to decrease annual runoff, base flow, and recharge to the bedrock; increase peak flow rates, variation in flow, and response to thunderstorms; reestablish the premining relation between surface and groundwater divides; and create fewer local flow systems in the shallow groundwater. (Lantz-PTT)
W89-09246

FLOOD-FLOW CHARACTERISTICS OF NANCY CREEK AT GEORGIA HIGHWAY 400 EXTENSION NEAR ATLANTA, GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09255

FLOODFLOW CHARACTERISTICS AT PROPOSED BRIDGE SITE FOR STATE HIGHWAY 99, KANSAS RIVER AT WAMEGO, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09267

4D. Watershed Protection

ANALYSIS OF BANK PROTECTION USING A PROBABILITY OF MOTION APPROACH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. K. Simons.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8618204. Ph.D. Dissertation, 1986. 179p, 33 fig, 14 tab, 87 ref, 3 append.

Descriptors: *Bank protection, *Probabilistic process, *Erosion control, *Bank erosion, Riprap, Rock properties, Velocity curve, Shear stress.

A probability of particle movement approach was applied in the analysis of riprap and wire-enclosed rock erosion protection to assess quantitatively the level of risk due to excessive velocity or shear. Design of wire-enclosed rock erosion protection was examined. Most riprap design methodologies fall into the factor of safety or the permissible velocity categories. Application of these methodologies results in a wide range of rock sizes for a given velocity. Traditional methods do not provide a quantitative assessment of how large a factor of safety is adequate or how far above or below a permissible velocity curve is safe. Risk analysis is a valid and useful technique which should be employed in erosion protection design. The probability of motion approach can be used as an indicator of percent damage to the bank protection. Laboratory tests show that the wire in rock in wire baskets aids in stabilizing the rock within the baskets. Because individual units of wire-enclosed

rock are generally heavier than individual rocks in riprap and they are tied together as a unit, the probability of motion of wire-enclosed rock is considerably lower when considering only the forces of lift and shear generated by the flow. (Cremmins-AEPCO)
W89-08253

NUMERICAL MODEL OF WATERSHED EROSION AND SEDIMENT YIELD,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 2J.
W89-08260

EROSION CONTROL APPARATUS,
Ero-Con, Inc., Eden Prairie, MN.
D. A. Atkins.
U.S. Patent No. 4,705,427; November 10, 1987, 5p, 2 fig. Official Gazette of the United States Patent Office, Vol 1084, No 2, p691, November 10, 1987.

Descriptors: *Patents, *Erosion control, *Soil erosion, *Slope degradation, *Furrows, Films, Hydraulic equipment, Barriers.

A wheeled trailer is used to install a perforate film erosion barrier into the earth along an elongated furrow path. A frame supports movement along a predetermined path. A plow shoe is disposed forward of the frame to create a film receiving furrow. A furrow-covering disc is contained at the rear of the frame and a perforated film supply roll is supported in a cradle that is intermediate to the plow shoe and the furrow-covering disc. A cable controls the elevation of the trailing boom relative to the frame. A hydraulic cylinder and ram, coupled between the frame and the trailing boom, adjustably positions the furrow-covering disc relative to the frame. (Cremmins-AEPCO)
W89-08287

METHOD AND APPARATUS FOR INHIBITING EROSION,
M. J. Nantz.
U.S. Patent No. 4,561,801; December 31, 1985, 6p, 3 fig. Official Gazette of the United States Patent Office, Vol 1061, No 5, p2124, December 31, 1985.

Descriptors: *Patents, *Erosion control, *Soil erosion, *Soil conservation, Surface runoff, Slope degradation, Channelization, Slope protection.

An upwardly open trough extending down the grade of a hillside inhibits erosion and conserves soil. The trough contains lateral skirts, which are buried in the hillside to a depth below the lowermost trough depth measured transversely. The skirts and the trough are impervious to water and are watertightly sealed. The trough forms a channel, which is transversely lowermost in a valley extending down the grade of the hillside. The valley contains sidewalls that gently slope toward the trough and are covered with sod. Runoff is directed by the valley to the trough where it is conducted down the hillside. (Cremmins-AEPCO)
W89-08289

UNDERWATER EROSION PREVENTION AND BACKFILL SYSTEM WITH BARRIER BAG INSTALLATION,
B. J. Albert.
U.S. Patent No. 4,571,121; February 18, 1986, 6p, 7 fig. Official Gazette of the United States Patent Office, Vol 1063, No 3, p 1237-1238, February 18, 1986.

Descriptors: *Patents, *Erosion control, *Backfill, *Barriers, *Sediment control, *Sediment erosion, Offshore platforms, Bottom sediments, Sediment transport, Scour.

Underscour and erosion are prevented and void spaces around undersea rigs, barges, and rig foundations are backfilled using a system which includes a sediment intake that is randomly movable by a diver. A handheld discharge unit dispenses sediment into barrier bags. A conduit connects the intake and discharge with a bore so that the sediment can be transmitted from the intake to the outlet. A fluid drive positioned in the conduit between the inlet and the outlet moves the mixture of sediment and seawater through the conduit. The fluid drive includes a fluid conveying tube having an inlet and outlet, which are connectable to the conduit. A branch conduit line extends angularly from the tube and forms an acute angle at the point of intersection with the tube. A fluid pump is connected to the branch conduit line for injecting a moving fluid mass into the bore of the tube so that the mass can produce flow through the conduit. For erosion control, void spaces created by a scour are first filled with sediment removed from the seabed next to a barge with a sediment intake. A handheld discharge unit then dispenses the sediment into the void space to be backfilled. After the void spaces are filled, a barrier of flexible wall containers or bags is placed about the perimeter of the barge. The bags are filled by transmission of a sand and fluid mixture into the barrier bags. (Cremmins-AEPCO)
W89-08290

APPARATUS FOR IMPEDING FINE SEDIMENT DEPOSITION IN HARBORS AND NAVIGATIONAL CHANNELS,
California Univ., Berkeley. Regents.
S. A. Jenkins.
U.S. Patent No. 4,661,013; April 28, 1987. 11p, 14 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1077, No 4, p 2142-2143, April 28, 1987.

Descriptors: *Patents, *Suspended sediments, *Bottom sediments, *Sediment control, *Deposition, Eddies, Channel scour, Waterways, Navigable waters.

A scouring and resuspension apparatus is mounted adjacent to the bottom of a waterway to impede the deposition of suspended sediments. The apparatus contains a buoyant wing with leading and trailing edges and flat top and bottom surfaces. A flap spans the wing and extends at a predetermined upward angle from the top surface towards the leading edge. Two standing eddies form when a current flows by the wing and flap. One of the eddies is formed adjacent to the top surface between the leading edge and the flap; the other eddy is formed adjacent to the top surface to the rear of the flap. The apparatus may be mounted in a berthing array comprised of downwashing wings located beneath a vessel and upwashing wings located about the perimeter of the vessel. The flap of the interior downwashing wings faces away from the waterway bottom to produce bottom scouring. The perimeter wings are mounted with the flap facing the bottom to produce downward lift for resuspending sediments upwardly. Alternately, the wings are mounted in a tuned array within a channel by cascading alternating upwashing and downwashing wings in the direction of the current. This arrangement generates internal wave motions near the bottom that enhance the scour and resuspension action of the wing array. (Cremmins-AEPCO)
W89-08291

REVETMENT SYSTEM FOR PREVENTING BLUFF EROSION,
H. J. Vignocchi.
U.S. Patent No. 4,655,637; April 7, 1987, 8p, 4 fig. Official Gazette of the United States Patent Office, Vol 1077, No 1, p270, April 7, 1987.

Descriptors: *Patents, *Erosion control, *Bank erosion, *Shoreline cover, *Shore protection, Slope protection, Slope stabilization, Sea walls, Breakwaters.

A revetment system prevents shoreline bluff or slope erosion from wave or hydrostatic forces using an elongate, three-dimensional, grid frame structure. The structure comprises interconnected frame elements and a mesh material covering portions of the periphery. The structure is adapted to be set into the slope so that the upper mesh covered surface is continuous with the natural contour of the slope. Aggregate material fills the volume defined within the frame structure. The material is of a size such that water may move freely through it. A filter fabric liner overlies the surface of the slope beneath the structure. The liner is sufficiently porous to allow water to pass through, while preventing the movement of solid material from the slope. The line and the aggregated material prevent the buildup of hydrostatic pressure behind the revetment system by allowing the flow of water and preventing the soil of the slope from washing through it. (Cremmins-AEPCO)
W89-08292

METHOD OF CAUSING SEDIMENTATION OF SEDIMENTARY SOLID MATERIAL TRANSPORTED IN A BODY OF WATER, SUCH AS A LAKE, A SEA, OR AN OCEAN,
Geoteknisk Inst., Lyngby (Denmark).
H. Vesterby.
U.S. Patent No. 4,645,377; February 24, 1987, 8p, 5 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1075, No 4, p1948, February 24, 1987.

Descriptors: *Patents, *Shore protection, *Land reclamation, *Suspended sediments, *Sedimentary structures, Subsurface drains, Drainage systems, Erosion control.

Sedimentation of suspended or other sedimentary solid material occurs at the upper surface of a porous substratum of a lake, a sea, or an ocean and along a bordering coastline or the edge of a lake between the body of water and an adjacent land area. A drain extending along and adjacent to the borderline removes water. The drain is positioned below the mean upper surface level of the water. The removed water reduces the hydraulic pressure in the porous substratum immediately below the upper surface in a zone along the borderline. Sedimentation or accretion of sedimentary material may thus be obtained in a broad zone on the water side of the borderline or coastline without the use of transversely extending drains. Such sedimentation or accretion of sedimentary material may be used for protection of sea coasts or lake edges exposed to erosion and for land reclamation. Water may be removed from the drain continuously or discontinuously; for example, it may be removed during storm degradation and be stopped during natural accretion. (Cremmins-AEPCO)
W89-08293

METHOD OF RAISING AND EXTENDING AN OCEAN BEACH,
For primary bibliographic entry see Field 8F.
W89-08294

DEVELOPING AN INTEGRATED MODEL FOR EVALUATING THE ECONOMIC AND ECOLOGIC EFFECTS OF REDUCING NON-POINT SOURCE POLLUTION IN A PALOUSE WATERSHED,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 6A.
W89-08344

TRANSPORT PROCESSES AT THE CATCHMENT SCALE,
Institute of Hydrology, Powys (Wales). Fluvial Geomorphology Unit.
For primary bibliographic entry see Field 2J.
W89-08941

MOUNTAIN TORRENT EROSION,
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
For primary bibliographic entry see Field 2J.
W89-08951

EFFECT OF BANK PROTECTION MEASURES, STEHEKIN RIVER, CHELAN COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
L. M. Nelson.

Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4316, 1986. 22p, 9 fig, 4 tab, 4 ref.

Descriptors: *Bank protection, *Environmental effects, *Stehekin River, *Water resources development, *Flood protection, *Erosion control, *Flood peak, Washington, Flow velocity, Flood protection, Levees, Dikes.

An investigation of the lower Stehekin River was conducted to study the effects on flood elevations and velocities from four bank protection and flood prevention measures that are being contemplated as a means of reducing erosional losses of river bank property. These measures are: bank armoring, armored revetment levees, spur dikes, and redevelopment of old cutoff channels. The banks at seven study sites could be armored without adverse effect on the flood velocities and elevations. The largest increases due to armoring--up to 1.6 ft/sec in velocity and 1 ft in elevation--occurred in the vicinity of sites 5, 6, and 7 where the gradient of the river channel is about 50 ft/mi and the velocities are high to begin with (about 6 to 13 ft/sec). The use of a levee in conjunction with armoring on the northeast bank from sites 5 to 7 would increase the velocities as much as 2.8 ft/sec and increase the elevation as much as 1 ft, but it would also provide some flood protection to the east bank, which is frequently inundated. Spur dikes were considered a practical alternative only at site 3, where reduced bank erosion may occur without aggravating flood inundation or erosion elsewhere. The rerouting of flood flow through an old cutoff channel near site 1 increased the velocity by 3.2 ft/sec and the elevation by 1 ft for the 100-year flood; however, it would move floodwater away from residential property where bank erosion is a problem. The few other old channels that shortcut river bends where much erosion occurs are apparently already part of the channel during floods. (Author's abstract)
W89-09022

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COMPARISON OF TWO METHODS FOR THE DETECTION OF FECAL POLLUTION IN DRINKING WATER,
Texas Univ., Houston. School of Public Health.
For primary bibliographic entry see Field 5F.
W89-08248

STATISTICAL ANALYSIS OF WATER QUALITY DATA AFFECTED BY LIMITS OF DETECTION,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 7C.
W89-08264

WATER QUALITY DATA FROM THE OBSERVATION WELL NETWORK IN ILLINOIS, 1985-87,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08308

COAL-SPOIL AND GROUNDWATER CHEMICAL DATA FROM TWO COAL MINES; HANNA BASIN AND POWDER RIVER BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. R. Larson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open-File Report 88-481, 1988. 18p, 1 fig, 6 tab, 10 ref.

Descriptors: *Groundwater pollution, *Wyoming, *Water analysis, *Water pollution sources, *Mine wastes, Chemical analysis, Groundwater, Spoil banks, Sulfur compounds, X-ray diffraction, Hanna basin, Powder River basin.

Data are presented describing chemical and mineralogical composition of spoil material and chemical quality of groundwater at 2 Wyoming mine sites. Samples were collected at Medicine Bow-Seminoe Number 1 mining area in the Hanna basin and at the Cordero Mine in the Powder River basin. The data collected from these sites, along with similar data from other coal-mining states in the West, are used to evaluate methods used in predicting post-mining groundwater quality. The data include mineral-composition analyses, paste-extract analyses, and sulfur-forms analyses of coal spoil, chemical analyses of water from batch-mixing experiments; and analyses of water samples collected from wells in the coal aquifers and from wells in the saturated spoils. (USGS)
W89-08316

EFFECT OF HERBICIDE RESIDUES ON MICROBIAL PROCESSES IN CROPLAND POND OR IMPOUNDMENT SEDIMENT,
Clemson Univ., SC. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W89-08328

MAINTENANCE OF CISTERN WATER QUALITY AND QUANTITY IN THE VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
R. H. Ruskin, and P. S. Callender.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115489/AS, price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 30, W.R.R.C., Caribbean Research Institute, University of the Virgin Island, St. Thomas, February 1988. 51p, 40 ref. USGS project G1258-02.

Descriptors: *Cisterns, *Water quality, *Virgin Islands (US), *Maintenance, Bioindicators, Coliforms, Pseudomonas, Sampling, Analytical techniques, Pollutant identification, Water pollution sources, Microbiological analysis.

Cisterns are readily subject to contamination because they are generally not sealed and are exposed to the environment. In this study of 20 private residential cisterns it was found that if only overall averages were considered, then not one of them would have met the Safe Drinking Water standard of 1 total coliform/100 mL and only 4 of the 20 would have met this limit 50% or more of the time. It was determined that the source of the contamination is almost soley environmentally associated, as a result it is felt that a fecal coliform standard would be a better indicator of water quality. What cannot be determined by a coliform test, is the occurrence of Pseudomonas aeruginosa, an opportunistic pathogen known to cause both ear infections and diarrheal disease, and which is frequently found in cistern water. The best way of controlling these microbial contaminants is via chlorination and through proper cistern maintenance practices. Even though the rainfall is about 45 in/year, residents are very conscientious about water conservation and use between 20-50 gal/day/person. (USGS)
W89-08336

EFFECT OF PREOZONATION ON THE ANAEROBIC BIODEGRADATION OF RESISTANT PHENOLIC COMPOUNDS,
Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5C.
W89-08338

GROUNDWATER CONTAMINATION FOR AGRICULTURALLY APPLIED PESTICIDES,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
M. J. Morra.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115547/AS, price codes: A04 in paper copy, A01 in microfiche. Idaho Water Resources Institute, Moscow, Completion Report, May 1988. 42p, 21 fig, 1 tab, 36 ref. USGS contract 14-08-0001-G1419. USGS project G1419-04.

Descriptors: *Pollutant identification, *Infrared spectroscopy, *Pesticides, *Soil columns, *Agricultural chemicals, *Groundwater pollution, Pesticides residues, Idaho, Analytical techniques, Humic acid, Fulvic acid, Soil extracts, Reflectance techniques.

Fourier Transform Infrared spectroscopy was combined with a Cylindrical Internal Reflectance (CIR) sample cell to determine the infrared spectra of soil extracts. The developed techniques are being used to qualitatively and quantitatively study pesticide interactions with water soluble complexing agents as related to the potential for complexation to increase pesticide transport. Spectral scans from 670 to 4000 cm indicate that the region of greatest resolution for observing characteristic humic acid absorbance bands occurs from 1000 to 2000/cm. Absorbance bands reflecting ester-bonded polysaccharides (1050, 1088, and 1164/cm) were detected. CIR was also used to obtain the spectra of soil extracts in the form of dissolved humic and fulvic acids as well as water soluble materials. Comparison of CIR spectra with a traditional nonaqueous sampling procedure (Nujol mull) demonstrated increased C-H peak intensities and near total elimination of ester absorbance peaks in the mull preparation. (USGS)
W89-08342

LABORATORY PLANNING FOR WATER AND WASTEWATER ANALYSIS,
Laboratory Consultants, Albuquerque, NM.
For primary bibliographic entry see Field 5D.
W89-08369

COAL SPOIL AND GROUNDWATER CHEMICAL DATA FROM TWO COAL MINES; HANNA BASIN AND POWDER RIVER BASIN, WYOMING,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08386

CONCENTRATIONS OF SELECTED TRACE INORGANIC CONSTITUENTS AND SYNTHETIC ORGANIC COMPOUNDS IN THE WATER TABLE AQUIFERS IN THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Memphis, TN. Water Resources Div.
B. W. McMaster, and W. S. Parks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-485, (1988). 30p, 5 fig, 5 tab, 13 ref.

Descriptors: *Water quality, *Groundwater, *Trace elements, *Organic compounds, *Pesticides, Groundwater pollution, Aquifer, Alluvium, Fluvial deposits, Memphis area, Tennessee.

Water quality samples for analysis of selected trace inorganic constituents and synthetic organic compounds were collected from 29 private or observation wells in alluvium and fluvial deposits of Quaternary and Tertiary Age. The alluvium and fluvial deposits are the water table aquifers in the Memphis area. In addition, nine wells were installed in Memphis Light, Gas and Water Division well fields so that samples could be collected and analyzed to characterize the quality of water in the fluvial deposits at these well fields. Samples from seven of these wells (two were dry) were analyzed for major constituents and properties of water as well as for selected trace inorganic constituents and synthetic organic compounds. Analyses of the water from most of the 36 wells sampled indicated ranges in concentration values for the trace inorganic constituents that agreed with those previous-

ly known, although some new maximum values were established. The analysis of water from four wells indicated that the water is or may be contaminated. Concentrations of barium (1,400 micrograms/L -- ug/L), strontium (1,100 ug/L), and arsenic (15 ug/L), along with specific conductance (1,420 microsiemens/centimeter--us/cm) were in water from one well in the alluvium. Low concentrations (0.02 to 0.04 ug/L) of the pesticides aldrin, DDT, endosulfan, and perthane were present in water from two wells in the fluvial deposits. Water from one of these wells also contained 1,1,1 trichloroethane (4.4 ug/L). Analysis of water from another well in the fluvial deposits indicated values for specific conductance (1,100 uS/cm), alkalinity (508 milligrams per liter -- mg/L -- as CaCO3), hardness (550 mg/L as CaCO3), chloride (65 mg/L), and barium (240 ug/L) that are high for water from the fluvial deposits. (USGS)
W89-08397

GROUNDWATER-QUALITY-MONITORING PROGRAM IN IOWA: NITRATE AND PESTICIDES IN SHALLOW AQUIFERS,
Geological Survey, Iowa City, IA. Water Resources Div.
M. G. Detroy, P. K. B. Hunt, and M. A. Holub.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4123, 1989. 31p, 11 fig, 14 tab, 24 ref.

Descriptors: *Monitoring, *Groundwater pollution, *Nitrates, *Herbicides, *Alluvial aquifers, *Pesticides, *Agricultural chemicals, Nonpoint pollution sources.

The Iowa groundwater-quality-monitoring program began in 1982. The program is operated by the U.S. Geological Survey in cooperation with the University of Iowa Hygienic Laboratory and the Iowa Department of Natural Resources. The objectives are to describe and assess the long-term chemical quality of the principal aquifers in Iowa and to direct water quality assessment and sampling toward regional groundwater-quality concerns. Six percent of the water samples collected from 515 individual shallow wells had nitrate concentrations larger than the maximum contaminant level for public drinking water of 10 mg/L as nitrogen. Eighteen percent of the samples had concentrations of nitrate between 5 and 19 mg/L as nitrogen. Water samples from 355 individual municipal wells less than 200 ft deep have been analyzed for pesticides at least once. Detectable concentrations of at least one pesticide, either alachlor, atrazine, cyanazine, dicamba, metolachlor, or metribuzine were detected in 20% of the samples. Atrazine was the most prevalent pesticide, detected in 18% of the samples. (USGS)
W89-08410

CONSTRUCTION, GEOLOGIC, AND WATER LEVEL DATA FOR OBSERVATION WELLS NEAR BRENTWOOD, WILLIAMSON COUNTY, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
D. W. Hanchar.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-248, 1989. 27p, 1 fig, 2 tab, 1 ref.

Descriptors: *Monitoring, *Path of pollutants, *Observation wells, *Waste dumps, *Hazardous materials, *Tennessee, Williamson County.

Thirty-four observation wells were installed at 17 sites in the area of a hazardous-waste disposal site near Brentwood, in Williamson County, Tennessee. These wells were installed to supplement data collected from domestic wells in the area, to help define the geology of the study area and to determine the water levels. Both lithologic and geophysical logs were obtained for each well drilled to help define the formations encountered. Four limestone units, corresponding to the Bigby-Cannon limestone, the Hermitage Formation, the Carters Limestone (including the T-3 bentonite), and the Lebanon Limestone, were described from well cuttings and borehole geophysical logs. Water levels have been collected at both the shallow and deep wells at each site. (USGS)
W89-08414

PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS OF THE BOISE RIVER FROM VETERANS MEMORIAL PARKWAY, BOISE TO STAR, IDAHO, OCTOBER 1987 TO MARCH 1988,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-08417

ASSESSING THE SENSITIVITY OF HIGH ALTITUDE NEW MEXICAN WILDERNESS LAKES TO ACIDIC PRECIPITATION AND TRACE METAL CONTAMINATION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
T. Lynch, C. Popp, G. Jacobi, and J. Robertson.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148456/AS, price codes: A09 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 234, October 1988. 177p, 11 fig, 21 tab, 107 ref, 13 append. USGS contract 14-08-0001-G1505. USGS state project 1423697.

Descriptors: *Acid rain effects, *Pollutant identification, *Acid rain, *Diatoms, *Heavy metals, *Geochemistry, *Trace metals, Water quality, Water analysis, Biological analysis, Sediment cores, Precambrian rock, Pb-210 chronology, New Mexico, Santa Fe Lake, Truchas Lake.

Seventeen high mountain lakes in northern New Mexico were sampled to determine their present biological and chemical condition. In addition, sediment cores were collected at each of the lakes to determine trace metal concentrations, diatom assemblages, and mineralogies as a function of depth. Two of the cores were age-dated using Pb-210 chronology. Eight of the lakes exhibited low alkalinities and, therefore, low capacities for neutralization. These lakes were located in basins where the surface geology was comprised of Precambrian rocks. Atmospheric deposition appears to be contributing acid and trace metals associated with anthropogenic sources to some of the lakes. Trace metal accumulations in the upper layers of Santa Fe Lake began about 60 years ago and about 10 years ago in Truchas Lake. An acid pulse (pH 5.7) associated with snow melt was documented in Santa Fe Lake and corresponded with an observed decrease of Daphnia sp. populations. Peca clam densities also appeared to be lower in the low alkalinity lakes. Sediment diatom assemblages in cores from Santa Fe Lake and Truchas Lake appear to be shifting to more acid tolerant species than in the past. (USGS)
W89-08433

PLASMID PROFILE ANALYSIS FOR ASSESSING BACTERIOLOGICAL QUALITY OF NATURAL WATERS,
University of Southern Mississippi, Hattiesburg. Dept. of Chemistry.
J. A. Evans.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136832/AS, price codes: A03 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1431-03, July 1988. 13p, 7 fig, 2 tab, 13 ref. USGS contract 14-34-0001-G1431. USGS project G1431-03.

Descriptors: *Pollutant identification, *Plasmid profiles, *Water analysis, Water quality, Indicators, Bioindicators, Water pollution, Coliforms, Enterococci, Microbiology, Epidemiology, Stream pollution, Raw wastewater, Mississippi, Bouie River, Leaf River, Bacterial analysis.

Current methods of screening water for microbiological contamination do not reveal the actual source of the contamination. This project was carried out to determine if analysis of plasmid size profiles of bacteria found in freshwater could be used to determine the source of the bacteria. The objectives of the study were met. These were to (1) isolate coliforms above, at and below sewage outfalls into the Bouie and Leaf Rivers near Hattiesburg, Mississippi, (2) isolate plasmids from representative sample coliforms, (3) characterize the plasmids from each isolate by size on agarose gel electrophoresis, and (4) compare the size profiles of the plasmids originating at the different sites. A total of 537 plasmids were identified from 344 coliform isolates of E. coli obtained from the different sites. These plasmids were then compared by overall size, size groupings and number of plasmids/isolate. Results of this comparison showed that simply viewing the overall size distribution of plasmids could not adequately distinguish the source of the plasmid bearing E. coli collected from the natural water. Some comparisons suggested a more refined means of looking at the plasmid may be more beneficial in assessing water quality. For example, water impacted by known human contamination had coliforms with high incidence of low molecular weight plasmids. The project also provided one of the few baselines studies of plasmid size profiles in natural waters. (USGS)
W89-08444

COMPARISON OF LABORATORY PERFORMANCES,
Sandia National Labs., Albuquerque, NM. Environmental Programs Div.
J. H. Einerson, and P. C. Pei.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-006660. Price codes: A04 in paper copy, A01 in microfiche. Report No. SAND--88-0226C, March 1988. 33p, 11 tab, 9 ref, 6 append.

Descriptors: *Wastewater analysis, *Laboratories, *Pollutant identification, *Performance evaluation, Chemical analysis, Management planning, Wastewater treatment, Water analysis, Inorganic compounds, Cost, Comparison studies.

This study was initiated to select reliable, competent laboratories which could perform analyses of wastewater contaminants for the purpose of regulatory compliance. Ten laboratories were selected to participate in the competency tests. In addition to reviews of quality assurance plans, the laboratories were given check samples to test the accuracy and precision of their analytical techniques. The check samples were spiked with seven inorganic contaminants commonly found in wastewater discharges; these samples were sent along with other routine wastewater samples. Each of the laboratories was sent a letter which accompanied the samples specifying handling instructions. The laboratories' qualifications were based on six criteria: ability to customize reports, turnaround time, cost, precision and accuracy from the analyses of check samples, and evaluation of quality assurance documents. Each laboratory was scored and ranked by criteria; the overall scores produced a list of laboratories ranked in order of competence. (Lantz-PTT)
W89-08493

COMPARISON OF TRACE LEVEL CONCENTRATIONS FOR SILVER, ARSENIC, BARIUM, CADMIUM, AND LEAD IN DRINKING WATERS OBTAINED BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY AND ELECTROTHERMAL-VAPORIZATION ATOMIC ABSORPTION SPECTROSCOPY,
Los Alamos National Lab., NM.
R. Robinson, M. Bell, C. Burns, and D. Knab.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-001629, price codes: A03 in paper copy, A01 in microfiche. Report No. LA-11095-MS, November 1987. 41p, 7 tab, 5 ref, 22 append.

Descriptors: *Water analysis, *Silver, *Arsenic, *Cadmium, *Barium, *Lead, *Drinking water, *Chemical analysis, Mass spectrometry, Atomic absorption spectroscopy, Comparison studies, Pollutant identification.

Data obtained by two analytical methods, inductively coupled plasma-mass spectrometry (ICP-MS) and electrothermal-vaporization atomic absorption spectroscopy (ETVAA), were compared for concentration values of silver, arsenic, barium, cadmium, and lead in drinking water specimens, spiked analyte recoveries, and control samples. Similar concentrations were obtained for those metals in the natural waters by both methods. Several of the spike recoveries and control sample recoveries, however, varied significantly. For arsenic, the average spike recovery was 101% and the average control sample recovery was 108% using ICP-MS. Using ETVAA, average spike recovery and average control sample recovery were 127% and 114%, respectively. For barium, an average spike recovery of 104% using ICP-MS and an average spike recovery of 122% using ETVAA was obtained. The barium average control sample recovery was 101% when ICP-MS was used and 120% when ETVAA was used. These recoveries indicated a greater level of confidence for the arsenic and barium analytical data obtained using the ICP-MS method. In addition, ICP-MS has rapid multielement analytical technique capabilities with limits of quantification and data confidence comparable to those of ETVAA. The multielement capabilities and the relative ease of obtaining data make ICP-MS the preferred analytical technique. (Author's abstract)
W89-08496

FISH ACUTE TOXICITY SYNDROMES: APPLICATION TO THE DEVELOPMENT OF MECHANISM-SPECIFIC QSARS (QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIPS),
Environmental Research Lab.-Duluth, MN.
S. P. Bradbury.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214762. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/115, May 1988. 10p, 7 fig, 1 tab, 20 ref.

Descriptors: *Pollutant identification, *Bioassay, *Water pollution effects, *Toxicity, *Fish, *Model studies, Quantitative analysis, Water quality control, Trout, Fish physiology, Structure-activity Relationships, Mode of Action.

In the field of aquatic toxicology a number of groups have proposed and are using predictive models, based on quantitative structure activity relationships (QSARs), as rapid screening tools to identify potentially hazardous chemicals. Several QSARs are now available that predict the acute toxicity of narcotic-industrial chemicals. Predictions for compounds acting through more specific modes of action, which are generally more toxic, require alternative models. Implementation of mechanism-specific quantitative models will require the development of qualitative models that assign the proper mode of action, and respective QSAR, to a given chemical. Current efforts in developing the components of this model are focused on characterizing a toxic mode of action database from which the structural requirements for specific mechanisms can be elucidated. Approaches to defining modes of action include application of joint toxicity theory for chemical mixtures and the assessment of fish acute toxicity syndromes (FATS). FATS are distinct sets of in vivo rainbow trout (Salmo gairdneri) toxic responses that correspond to specific modes of action. By measuring a number of respiratory-cardiovascular variables, response sets associated with nonpolar and polar narcotics, oxidative phosphorylation uncouplers, respiratory membrane irritants, respiratory inhibitors, acetylcholinesterase inhibitors, and central nervous system seizure agents have described. (Author's abstract)
W89-08520

USE OF SHORT-TERM BIOASSAYS IN ESTIMATING HUMAN HEALTH HAZARDS OF WASTEWATER EFFLUENTS,
Health Effects Research Lab., Research Triangle Park, NC.
L. W. Condile, C. E. Easterly, and L. R. Glass.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220686. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/132, June 1988. 13p, 3 tab, 9 ref.

Descriptors: *Pollutant identification, *Wastewater, *Effluents, *Water quality, *Bioassay, *Public health, *Water pollution effects, Toxicity, Chemical analysis, Biological studies, Estimating hazards.

Effluents from wastewater treatment facilities are discharged as a complex mixture of numerous chemical substances, which may include cytotoxic, carcinogenic and mutagenic compounds. Historically, Federal and State Agencies have relied upon chemical-based analyses to set and enforce regulatory limits for these effluents. One problem with this approach is that many potentially hazardous chemicals are not quantifiable in complex chemical effluents but are none the less discharged into the environment. The U.S. EPA has recently established a research program to determine if a bioassay approach for evaluating the potential adverse human health effects from exposure to complex mixtures might supplement conventional chemical analysis for setting regulatory limits for wastewaters. This paper summarizes a bioassay testing strategy for characterizing cytotoxic and mutagenic activity of various wastewater effluents. The use of a relative potency framework for assessing complex mixtures for potential health hazards is addressed. (Author's abstract)
W89-08548

JRC PROGRAM FOR MARINE COASTAL MONITORING,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 7A.
W89-08585

WATER QUALITY MONITORING OF LAKE BALATON USING LANDSAT MSS DATA,
Tokai Univ., Hiratsuka (Japan). Research and Information Center.
For primary bibliographic entry see Field 7C.
W89-08599

DETERMINATION OF SPECTRAL SIGNATURES OF NATURAL WATER BY OPTICAL AIRBORNE AND SHIPBORNE INSTRUMENTS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 7B.
W89-08600

WATER AND STREAMBED-MATERIAL DATA, EAGLE CREEK WATERSHED, INDIANA, AUGUST 1980 AND OCTOBER AND DECEMBER 1982,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-215, 1983. 41p, 2 fig, 19 tab, 4 ref, 3 append.

Descriptors: *Data collections, *Streambeds, *Eagle Creek, *Pollutant identification, *Indiana, Water quality, Metals, Insecticides, Organic compounds, Volatile organic compounds, Chemical analysis.

Water quality studies within the Eagle Creek watershed, Indiana, were done by the U.S. Geological Survey in August 1980, October 1982, and December 1982 in cooperation with the city of Indianapolis, Department of Public Works. Streambed-material and water samples were collected from Finley and Eagle Creeks at various flow rates and were analyzed for selected metals, non-metals, insecticides, and acid-extractable and base-neutral-extractable compounds. Water samples also were analyzed for volatile organics. This report lists all the data collected and analyzed by the U.S. Geological Survey during the 1980 and 1982 surveys but does not interpret the data. (Author's abstract)
W89-08657

STATISTICAL SUMMARY OF DATA FROM THE U. S. GEOLOGICAL SURVEY'S NATIONAL WATER QUALITY NETWORKS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08661

QUALITY OF WATER AND BED MATERIAL IN STREAMS OF LOGAN TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY, 1984,
Geological Survey, Trenton, NJ. Water Resources Div.
J. J. Hochreiter, and J. Kozinski.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4300, 1985. 39p, 7 fig, 7 tab, 23 ref.

Descriptors: *Streams, *Streambeds, *Water quality, *Pollutant identification, New Jersey, Volatile organic compounds, Trace metals, Organochlorine, Organophosphorus, Organic compounds, Racoon Creek, Methylene chloride, Polychlorinated biphenyls, Sediment contamination.

The surface water and surficial-bed material at seven stations on three streams in Logan Township, Gloucester County, New Jersey, were sampled in the fall of 1984. Samples of water were analyzed for volatile organic compounds, trace metals, and organochlorine and organophosphorous compounds. Surficial-bed material was analyzed for extractable trace metals and organochlorine compounds. Water samples from two closely spaced sampling locations along Raccoon Creek contained elevated concentrations of methylene chloride (455 and 1800 micrograms/L, respectively), a volatile organic solvent. Bed-material samples taken from Little Timber and Birch Creeks contained elevated levels of trace metals and organochlorine compounds, including polychlorinated biphenyls (PCB's). Contaminant concentrations in bed-material samples taken from Raccoon Creek were much lower than those found previously by the U.S. Geological Survey in 1980. Only a trace of PCB's was detected in any bed material sample taken from Racoon Creek. Gas chromatographic flame-ionization detector scans, performed on solvent extracts of all water and sediment samples, were useful in characterizing the presence or absence of organic contaminants in those samples. Changes in the character of organic contamination along the reaches of two streams were apparent when the fingerprints of chromatograms representing upstream sites were compared to those representing downstream sites. (Author's abstract)
W89-08679

IDENTIFYING AND REDUCING LOSSES IN WATER DISTRIBUTION SYSTEMS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. W. Male, R. R. Noss, and I. C. Moore.
Noyes Publications, Park Ridge, New Jersey. 1985. 156p.

Descriptors: *Water loss, *Water distribution, *Water management, *Water conveyance, *Conveyance structures, Water supply, Meters, Leakage, Economic aspects, Maintenance, Water use efficiency, Water metering, Measuring instruments, Economic aspects.

This book provides guidelines for assessing problems associated with water supply systems. Included are recommendations for determining water use, estimating water system losses, evaluating alternatives for water system improvements, and ascertaining the benefits and costs involved. Chapter II presents a discussion of methods of keeping track of water flowing through a water distribution system. Guidelines are presented for evaluating and reducing water and revenue losses by utilizing a systematic method of accounting for water usage. Meters used for measuring water are the emphasis of Chapter III. Specifically, 5/8-in.

water meters are thoroughly discussed. Chapter IV's emphasis is on methods for determining water system leakage. Water audits, leak detection surveys and equipment such as sonic leak detectors are discussed. The economics of leak detection and repair are discussed in Chapter V, and Chapter VI discusses funds for system rehabilitation work that are available from a governmental agency for distribution to a number of communities. A linear programming formulation is developed for allocating such funds. Multiobjective formulations are designed to incorporate objectives which maximize the water saved, the net benefits and the fairness involved in the distribution of funds. (Lantz-PTT)
W89-08698

CONTROL OF ORGANIC SUBSTANCES IN WATER AND WASTEWATER.
For primary bibliographic entry see Field 5D.
W89-08701

IDENTIFICATION AND DESCRIPTION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08722

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, APALACHICOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08723

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, DAYTONA BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08724

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, FORT PIERCE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08725

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, GAINESVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08726

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS JACKSONVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08727

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, KEY WEST 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08728

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, MIAMI 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08729

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, ORLANDO 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08730

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, PENSACOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08731

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TALLAHASSEE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08732

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TAMPA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08733

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, TARPON SPRINGS 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08734

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, VALDOSTA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08735

LOCATION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS, WEST PALM BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
For primary bibliographic entry see Field 7C.
W89-08736

RECONNAISSANCE OF SELECTED ORGANIC CONTAMINANTS IN EFFLUENT AND GROUND WATER AT FIFTEEN MUNICIPAL WASTEWATER TREATMENT PLANTS IN FLORIDA, 1983-84,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5D.
W89-08746

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY FOR WATER-YEAR 1982,
Geological Survey, Denver, CO. Water Resources Div.
D. B. Peart, and N. A. Thomas.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 83-4264, 1983. 112p, 180 fig, 6 tab, 8 ref.

Descriptors: *Laboratories, *Quality control, *Chemical analysis, *Water analysis, *Data interpretation, Inorganic compounds, Pollutant identification, Statistical analysis, Data collections, Arsenic, Zinc, Sodium, Iron, Copper, Beryllium, Fluorides, Molybdenum, Nickel, Cadmium, Chromium, Manganese, Selenium, Silver, Sodium.

The U.S. Geological Survey (USGS) maintains a quality assurance program based on the analysis of reference samples for its two water analysis laboratories located in Atlanta, Georgia, and Denver, Colorado. Reference samples containing inorganic constituents are prepared at the USGS Ocala, Florida, office and disguised as routine samples, and sent daily to each laboratory through other USGS offices. The results are permanently stored in the National Water Data Storage and Retrieval System (WATSTORE), the USGS data base for all water data. These data are analyzed statistically for precision and bias. The results of these statistical analyses are presented for data collected during the 1982 water year. In addition, one sample containing known concentrations of trihalomethanes was analyzed in both laboratories, and these results also are presented. Recurring problems with lack of precision existed in Atlanta for arsenic; calcium (ICP); iron, total recoverable; sodium (ICP); and zinc, total recoverable; and in Denver for chloride; copper, total recoverable; and specific conductance. Significant bias recurred in Atlanta for arsenic; beryllium; fluoride; molybdenum; nickel; potassium; silica; and zinc; and in Denver for antimony; arsenic; barium; cadmium; cadmium, total recoverable; chromium, total recoverable; cobalt; cobalt, total recoverable; dissolved solids; fluoride; magnesium (ICP); molybdenum; nickel; nickel, total recoverable; selenium; silver; silver, total recoverable; sodium (ICP); sodium (AA); specific conductance; sulfate; zinc; and zinc, total recoverable. The quality assurance samples were contaminated with iron during preparation beginning in July, 1981, and continuing through March, 1982. Therefore, no evaluation of iron or iron, total-recoverable data was made for this period. (Lantz-PTT)
W89-08767

CHEMICAL QUALITY OF PRECIPITATION AT GREENVILLE, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2B.
W89-08787

DETECTION OF CONTAMINANT PLUMES IN GROUND WATER OF LONG ISLAND, NEW YORK, BY ELECTROMAGNETIC TERRAIN-CONDUCTIVITY SURVEYS,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08794

SELECTED METHODS FOR DISSOLVED IRON (II, III) AND DISSOLVED SULFIDE (-II) DETERMINATIONS IN GEOTHERMAL WATERS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-08811

DATA ON SURFACE-WATER QUALITY AND QUANTITY, LOWER EDGEWOOD CREEK BASIN, DOUGLAS COUNTY, NEVADA, 1984-85,
Geological Survey, Carson City, NV. Water Resources Div.
R. J. La Camera, and S. B. Browning.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-565, 1988. 18p, 1 fig, 3 tab, 4 ref.

Descriptors: *Water quality, *Surface water, *Edgewood Creek, *Pollutant identification, *Nevada, Hydrologic budget, Stream discharge, Ammonium, Nitrogen, Nitrites, Nitrates, Phosphorus, Suspended sediment, Iron, Manganese, Zinc, Water temperature, Specific conductivity, Hydrogen ion concentration, Dissolved oxygen, Chemical analysis.

Selected hydrologic data were collected from August 1984 through July 1985 at three sites on the lower part of Edgewood Creek, and at a recently constructed sediment-catchment basin that captures and retains runoff from developed areas in the lower Edgewood Creek drainage. The data were collected to quantify the discharge of selected constituents downstream from recent and planned watershed restoration projects, and to Lake Tahoe. Contained in this report are the results of quantitative analyses of 39 water samples for: total and dissolved ammonium, organic nitrogen, nitrite, nitrate, phosphorus, and orthophos-

phorus; suspended sediment; total iron, manganese, and zinc; and dissolved temperature, specific conductance, pH, and dissolved oxygen; summary statistics (means and standard deviations), and computations of instantaneous loads. On the basis of mean values, about 80% of the total nitrogen load at each of the three Edgewood Creek sites is in the form of organic nitrogen, 12% is in the form of nitrate nitrogen, 7% is in the form of ammonium nitrogen, and 1% is in the form of nitrite nitrogen. The percentage of total phosphorus load in the form of orthophosphorus at the three stream sites varies somewhat with time, but is generally greater at the two downstream sites than at the upstream site. In addition, the percentage of the total phosphorus load that is present in the dissolved state generally is greater at the two downstream sites than at the upstream site. (Lantz-PTT)
W89-08998

DISSOLVED CONSTITUENTS INCLUDING SELENIUM IN WATERS IN THE VICINITY OF KESTERSON NATIONAL WILDLIFE REFUGE AND THE WEST GRASSLAND, FRESNO AND MERCED COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09040

SYNTHESIS OF THE RESULTS OF THE FIELD VERIFICATION PROGRAM WETLAND DISPOSAL ALTERNATIVE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-09046

SUMMARY OF DATA ON MUNICIPAL SOLID WASTE LANDFILL LEACHATE CHARACTERISTICS: 'CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS', (40 CFR PART 258),
NUS Corp., Rockville, MD.
R. Nace, P. Irle, D. Habib, T. Kimmell, and P. Cassidy.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242441. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/530-SW-88-038, July 1988. 140p, 3 fig, 8 tab, 11 ref, 3 append. EPA contract 68-01-7410.

Descriptors: *Waste disposal, *Leachates, *Landfills, *Pollutant identification, Solid wastes, Organic compounds, Hazardous wastes, Inorganic compounds, Pesticides, Polychlorinated biphenyls, Herbicides, Volatile organic compounds.

Municipal solids waste landfill (MSWLF) leachates: were studied to determine some of the constituents (inorganic compounds, pesticides, herbicides, polychlorinated biphenyls, volatile organic compounds, and semivolatile organic compounds) present, the concentrations of the constituents relative to human health and environmental regulatory standards, and the effect of Subtitle C hazardous waste regulations on constituent concentrations in MSWLF leachate. For each site, the number of times the concentration of a constituent exceeded a standard and exceeded 1,000 times the standard were counted. The value 1,000 times the standard was arbitrarily selected to represent attenuation of the leachate constituents prior to human exposure. The tabulated results were put in one of four groups by number of standards exceeded: zero; only one; two to four; and five or more. Sites were grouped according to pre-1980, post-1980 and undated MSWLFs and hazardous waste landfills. The results are shown both as fractions and as percents. The denominator of the fractions represent the number of sites in the given landfill category. Pre-1980 MSWLF sites exceeded five or more standards somewhat more frequently than either the hazardous waste landfill sites or the post-1980 sites. Both pre- and post-1980 MSWLF sites were more likely not to exceed 1,000 times any standard than were hazardous waste landfill sites. (Lantz-PTT)
W89-09048

CLOSED-LOOP STRIPPING, COMBINED WITH CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY ANALYSIS TO DEFINE A SEMI-VOLATILE ORGANIC CONTAMINANT PLUME,
Geological Survey, Boston, MA. Water Resources Div.
L. B. Barber, E. M. Thurman, and M. P. Schroeder.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 89-113, 10 fig, 5 tab, 27 ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Mass spectrometry, *Plumes, *Groundwater pollution, *Volatile organic compounds, *Groundwater pollution, Chemical analysis, Trichloroethene, Tetrachloroethene, Organic compounds, Inorganic compounds, Phenols, Benzenes, Chlorinated hydrocarbons.

Thirty-two wells were sampled using closed-loop stripping combined with capillary gas chromatography/mass spectrometry analysis, to establish whether or not semi-volatile organic compounds are present in a plume of sewage contaminated groundwater at Otis Air Base, Cape Cod, Massachusetts. Approximately 40 different organic compounds were tentatively identified in the groundwater at the s. Of these substances, trichloroethene and tetrachloroethene were present in all wells sampled within the plume delineated by inorganic constituents. Dichlorobenzene, alkylated phenols, and alkylated benzenes were also present in many of the wells. Contaminant distributions were qu complex, and probably reflect variations in source composition. The closed-loop stripping technique allowed determination of organic compounds at the low nanogram/L (ng/L) concentration level. The semi-volatile plume defined by the closed-loop stripping technique is considerably larger in areal extent than the plume determined by a purge and trap method; the latter has a detection limit in the low microgram/L range. Based on this study, it was concluded that closed-loop stripping combined with capillary gas chromatography/mass spectrometry is an effective method for determination of semi-volatile organic contaminants at the ng/L level in ground water. (See also W89-09052) (Author's abstract)
W89-09056

REPORT OF THE U.S. GEOLOGICAL SURVEY'S ANALYTICAL EVALUATION PROGRAM--STANDARD REFERENCE WATER SAMPLES M-82 (MAJOR CONSTITUENTS), T-83 (TRACE CONSTITUENTS), N-8 (NUTRIENTS), AND P-2 (PRECIPITATION SNOWMELT),
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09075

METHODS FOR DETERMINATION OF INORGANIC SUBSTANCES IN WATER AND FLUVIAL SEDIMENTS.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09097

AMBIENT WATER QUALITY CRITERIA FOR ALUMINUM-1988.
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
For primary bibliographic entry see Field 5G.
W89-09113

BIAS AND PRECISION OF SELECTED ANALYTES REPORTED BY THE NATIONAL ATMOSPHERIC DEPOSITION PROGRAM AND NATIONAL TRENDS NETWORK, 1984,
Geological Survey, Lakewood, CO. Water Resources Div.
M. H. Brooks, L. J. Schroder, and T. C. Willoughby.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4050, 1987. 19p, 8 fig, 5 tab, 8 ref.

Descriptors: *Acid rain, *Quality control, *Laboratories, *Pollutant identification, *Sampling, *Performance evaluation, Rainfall, Magnesium, Calcium, Potassium, Chlorides, Sulfates, Chemical analysis.

The U.S. Geological Survey operated a blind audit sample program during 1974 to test the effects of the sample handling and shipping procedures used by the National Atmospheric Deposition Program and National Trends Network on the quality of wet deposition data produced by the combined networks. Blind audit samples, which were dilutions of standard reference water samples, were submitted by network site operators to the central analytical laboratory disguised as actual wet deposition samples. Results from the analyses of blind audit samples were used to calculate estimates of analyte bias associated with all network wet deposition samples analyzed in 1984 and to estimate analyte precision. Concentration differences between double blind samples that were submitted to the central analytical laboratory and separate analyses of aliquots of those blind audit samples that had not undergone network sample handling and shipping were used to calculate analyte masses that apparently were added to each blind audit sample by routine network handling and shipping procedures. These calculated masses indicated statistically significant biases for magnesium, sodium, potassium, chloride, and sulfate. Median calculated masses were 41.4 micrograms (ug) for calcium, 14.9 ug for magnesium, 23.3 ug for sodium, 0.7 ug for potassium, 16.5 ug for chloride and 55.3 ug for sulfate. Analyte precision was estimated using two different sets of replicate measures performed by the central analytical laboratory. Estimated standard deviations were similar to those previously reported. (Author's abstract)
W89-09177

PH MEASUREMENT OF LOW-CONDUCTIVITY WATERS,
Geological Survey, Reston, VA. Water Resources Div.
E. Busenburg, and L. N. Plummer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4060, 1987. 21p, 2 fig, 2 tab, 14 ref.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Water analysis, *Conductivity, Chemical properties, Sulfuric acid.

pH is an important and commonly measured parameter of precipitation and other natural waters. The various sources of errors in pH measurement were analyzed and procedures for improving the accuracy and precision of pH measurements in natural waters with conductivities of < 100 uS/cm at 25 C are suggested. Detailed procedures are given for the preparation of dilute sulfuric acid standards to evaluate the performance of pH electrodes in low conductivity waters. A daily check of the pH of dilute sulfuric acid standards and deionized water saturated with a gas mixture of low carbon dioxide at partial pressure (air) prior to the measurement of the pH of low conductivity waters is suggested. (Author's abstract)
W89-09182

ORGANOCHLORINE PESTICIDE RESIDUES IN BED SEDIMENTS OF THE SAN JOAQUIN RIVER AND ITS TRIBUTARY STREAMS, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09270

5B. Sources Of Pollution

NUMERICAL SIMULATION OF GROUNDWATER CONTAMINANT TRANSPORT ON A SUPERCOMPUTER WITH INJECTION-PUMPING NETWORKS USING THE MODIFIED MOC AND MFE METHOD,
Rice Univ., Houston, TX. Graduate School.
C. Y. Chiang.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8617434. Ph.D. Dissertation, 1986. 143p, 37 fig, 129 ref, 3 append.

Descriptors: *Groundwater pollution, *Groundwater movement, *Model studies, *Groundwater transport, *Simulation analysis, Finite element method, Injection, Pumping, Cleanup, Permeability coefficient, Computer models, Numerical analysis, Computer programs.

A general groundwater contaminant transport simulator was developed based on the Modified Method of Characteristics (MMOC) and Mixed Finite Element Method. The simulator was used to design injection-pumping networks for the remedial cleanup of a contaminated field site. Different boundary conditions were incorporated into the MMOC method to increase the flexibility of the code to handle more general practical problems. The code was tested for accuracy against analytical solutions for a single injection well and an injection pumping well pair. The MMOC method was compared with the USGS Solute Transport Model and the limits of the time step size in MMOC were evaluated. The grid size convergence also was evaluated and the code was applied to simulate random hydraulic conductivity fields using the Turning Bands Method. The MMOC method proved superior in many respects to other models of groundwater transport, especially in the presence of strong pumping or injection centers or heterogeneities in the flow field. (Cremmins-AEPCO)
W89-08240

MULTIPHASE IMMISCIBLE FLOW THROUGH POROUS MEDIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Graduate School.
J. Sheng.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8625806. Ph.D. Dissertation, 1986. 134p, 47 fig, 9 tab, 110 ref, 2 append.

Descriptors: *Numerical analysis, *Groundwater pollution, *Groundwater movement, *Model studies, *Leakage, *Storage tanks, *Oil pollution, Fluid flow, Flow characteristics, Porous media, Underground structures, Flow profiles, Immiscibility, Differential equations.

A numerical model was developed for three-phase immiscible flow in porous media with emphasis on accurate prediction of the oil phase of flow in soil from leaking underground tanks. The differential equations of immiscible flow were based on atmospheric air phase pressure, rigid porous materials, and incompressible fluids. Coupled differential equations were solved simultaneously using finite element methods. The capillary function of van Genuchten was applied to three-phase immiscible flow. Laboratory studies of soil columns initially saturated with water and displaced by p-cymene under constant pressure were simulated by the finite element model. Transient water outflow predicted using independently measured capillary head-saturation data agreed well with observed outflow data. Two dimensional simulations are presented for hypothetical field cases of the introduction of an organic fluid near the soil surface due to leakage from an underground storage tank. (Cremmins-AEPCO)
W89-08245

THREE-PHASE FLOW ANALYSIS OF OIL SPILLS IN PARTIALLY WATER-SATURATED SOILS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
C. A. Lujan-Sierraalta.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8607657. Ph.D. Dissertation, 1985. 132p, 29 fig, 3 tab, 120 ref.

Descriptors: *Flow characteristics, *Saturated soils, *Oil spills, *Groundwater pollution, *Model studies, *Groundwater movement, *Path of pollutants, Mathematical models, Numerical analysis, Sensitivity analysis, Flow profiles, Fluid flow.

A model was developed of the flow of three-phase immiscible fluids in partially water-saturated soils, in which the movement of oil after a spill can be predicted. Sensitivity analysis showed that air confinement does not significantly reduce the oil infiltration rate. Therefore, a two-phase version of the Galerkin finite element program OILSPL could be developed. The three-phase model would be used for situations in which the changes in air pressure and flow play a significant role. The difficulties of simulating the advancement of an oil front in soils with values of lambda greater than five should not be a major restriction of the use of the numerical model, given that most spills have lambda values of less than four. The numerical model OILSPL should prove to be helpful in predicting the response of oil to diverse conditions such as a fluctuating water table, air or water injections, and rain; as well as to estimate the time required for the front to reach the water table. (Cremmins-AEPCO)
W89-08246

CHEMICAL BEHAVIOR OF PARTICULATE AND STABILIZED OIL ASH WASTE IN SEAWATER,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 5E.
W89-08247

STOCHASTIC ANALYSIS OF POLLUTANT MOVEMENT IN GROUNDWATER,
Iowa State Univ., Ames. Dept. of Civil Engineering.
K. K. Wolka.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8615095. Ph.D. Dissertation, 1986. 141p, 30 fig, 24 tab, 34 ref, append.

Descriptors: *Path of pollutants, *Dispersion, *Groundwater movement, *Stochastic process, *Groundwater pollution, *Permeability coefficient, Model studies, Statistical analysis, Synthetic hydrology, Mathematical models.

A procedure was developed to introduce probability into estimations of the magnitude and duration of exposure of a pollutant. The spatial variability of hydraulic conductivity was incorporated into the procedure, which was then validated using a pollutant disposal event under field conditions. Statistical analyses were performed to describe the results of the disposal event. The Turning Bands Method of generating spatially-varying, correlated hydraulic conductivity fields works quickly and inexpensively on the computer, with practical limitations. Either a transmissivity contour map or borings for hydraulic conductivity testing are required to obtain good estimates of the mean, standard deviation, and correlation function. The shape of the pollutographs at an observation well is extremely sensitive to the hydraulic gradient of the aquifer. A large difference in concentrations between recorded and synthetic disposal events is associated with differences in seepage velocities. The contention that dispersion in the field is due mainly to spatial variability in hydraulic conductivity, rather than a dispersion coefficient, is apparently a valid one. Statistical tests on model results indicated that the arrival of the pollutant to an observed location tended to follow a non-normal pattern. (Cremmins-AEPCO)
W89-08250

TWO-DIMENSIONAL FINITE-ELEMENT PROGRAMS FOR WATER FLOW AND WATER QUALITY IN MULTI-AQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2F.
W89-08257

HYDROGEOLOGY AND WATER SUPPLY POTENTIAL OF THE WATER TABLE AQUIFER ON DAUPHIN ISLAND, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08310

STATISTICAL SUMMARY OF THE CHEMICAL QUALITY OF SURFACE WATER IN THE POWDER RIVER COAL BASIN, THE HANNA COAL FIELD, AND THE GREEN RIVER COAL REGION, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-08311

COAL-SPOIL AND GROUNDWATER CHEMICAL DATA FROM TWO COAL MINES; HANNA BASIN AND POWDER RIVER BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08316

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 1: HYDROGEOLOGY AND WATER QUALITY,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08318

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK PART 3: SIMULATION OF SOLUTE TRANSPORT,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08321

WATER RESOURCES ACTIVITIES IN NEW YORK, 1987-88,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-08322

MUNICIPAL GROUNDWATER CONTAMINATION IN MASSACHUSETTS: THE CASE FOR WELLHEAD PROTECTION IN HUMID REGIONS,
Massachusetts Univ., Amherst. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W89-08331

HYDROLOGIC AND MINING DATA FROM AN AREA OF UNDERGROUND COAL MINING IN GARRETT COUNTY, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08333

POTENTIAL OF SURFACE WATER CONTAMINATION FROM THREE TRIAZINE HERBICIDES,
Kentucky Water Resources Inst., Lexington.
W. W. Witt, and K. W. Sander.
Available from National Technical Information

Service, Springfield, VA 22161 as PB89-113880/AS, price codes: A03 in paper copy, A01 in microfiche. Research Report No. 171, September 1988. 14p, 6 tab. USGS contracts 14-08-0001-G1227 FY-86 and 14-08-0001-G1424 FY-87. USGS projects (A-110-KY) G1227-05 and G1424-05.

Descriptors: *Herbicides, *Tillage, *Path of pollutants, *Triazines, Runoff, Surface water, Groundwater, Atrazine, Cyanazine, Simazine, Rainfall.

The movement of atrazine, cyanazine and simazine from the site of application was monitored under conventional, reduced an no-tillage conditions. Less water and soil was lost from no-tillage and reduced tillage conditions. Conventional and tillage conditions had about 66,000 L/ha runoff in 1986-87 and about 123,000 L/ha runoff in 1987-88. Seasonal rainfall was 885 mm in 1986-87 and 397 mm in 1987-88. The rainfall intensity was greater during the first two events in 1987 than the corresponding events in 1986. The first rainfall event in 1986 accounted for 91, 89 and 78% of the total seasonal loss of atrazine, cyanazine and simazine, respectively. More simazine was found in the surface runoff water than was atrazine or cyanazine. (USGS)
W89-08334

MAINTENANCE OF CISTERN WATER QUALITY AND QUANTITY IN THE VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
For primary bibliographic entry see Field 5A.
W89-08336

PREDICTING POTENTIAL ALUMINUM CONTAMINATION OF SURFACE AND GROUNDWATERS FROM ACID SULFATE ENRICHED DRAINAGES EMANATING FROM LOW NEUTRALIZATION CAPACITY WATERSHEDS,
Kentucky Water Resources Research Inst., Lexington.
A.D. Karathanasis, V. P. Evangelou, and Y. L. Thompson.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115513/AS, price codes: A05 in paper copy, A01 in microfiche. Research Report No. 170, August 1988. 78p, 21 fig, 22 tab, 50 ref. USGS contract 14-08-0001-G1227 (FY 86) and 14-08-0001-G1424 (FY 87). USGS projects A-109-KY G1227-04 and G1424-04.

Descriptors: *Soil solution, *Mine drainage, *Strip mines, *Dissolved aluminum, *Aluminum sulfate, Water flow rates, Mineral equilibria, Acid soils, Kentucky, Watersheds, Dissolved solids, Water pollution sources, Path of pollutants.

The composition of soil solutions and surface waters emanating from unreclaimed, or partially reclaimed, strip-mined watersheds with low buffering capacity in Kentucky were compared with soil solution compositions of unaffected strata in the watershed. The data suggest that almost 20 years after mining, most soil solutions and surface waters of the disturbed areas still contain high levels of dissolved Al, controlled primarily by the solubilities of a jubanite-like mineral (upper limit) and alunite (lower limit). Soluble Al in solutions of undisturbed areas was consistent with the solubility of laolinite or gibbsite. The absence of jubanite x-ray diffraction peaks suggested the presence of an amorphous mineral or one stoichiometrically similar to jubanite. Despite greater residence times for soil solutions as compared to surface water, the compositional differences were insignificant. The control of soluble Al by basic aluminum sulfate minerals was not affected by the variable mineralogical and tectural composition of soil and geological strata in the watershed. Apparently, this is the result of low buffering capacity. At pH 4, pH and sulfate activities can be used to predict accurately the levels of soluble A1(3+) in surface and groundwaters of the watershed. Similar predictions from pH and S0(24--) activities can also be made for dissolved Fe(3+) levels, supporting the stoichometry but a much higher solubility than that of jarosite. (Huffsey-UKY, WRRI)
W89-08337

GROUNDWATER CONTAMINATION FOR AGRICULTURALLY APPLIED PESTICIDES,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 5A.
W89-08342

DEVELOPING AN INTEGRATED MODEL FOR EVALUATING THE ECONOMIC AND ECOLOGIC EFFECTS OF REDUCING NON-POINT SOURCE POLLUTION IN A PALOUSE WATERSHED,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 6A.
W89-08344

ASSESSMENT OF GROUNDWATER CONTAMINATION IN THE ALLUVIAL AQUIFER NEAR WEST POINT, KENTUCKY,
Geological Survey, Reston, VA. Water Resources Div.
M. A. Lyverse, and M. D. Unthank.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4166, Jan 1989. 25p, 11 fig, 2 tab, 9 ref.

Descriptors: *Groundwater pollution, *Oil wells, *Contamination, *Brines, *Alluvial aquifers, *Water pollution sources, Geophysics, Borehole geophysics, Chlorides, Electromagnetic waves.

Well inventories, water level measurements, groundwater quality samples, surface geophysical techniques (specifically, electromagnetic techniques), and test drilling were used to investigate the extent and sources of groundwater contamination in the alluvial aquifer near West Point, Kentucky. This aquifer serves as the principal source of drinking water for over 50,000 people. Groundwater flow in the alluvial aquifer is generally unconfined and moves in a northerly direction toward the Ohio River. Two large public supply well fields and numerous domestic wells are located in this natural flow path. High concentrations of chloride in groundwater have resulted in the abandonment of several public supply wells in the West Point areas. Chloride concentrations in water samples collected for this study were as high as 11,000 mg/L. Electromagnetic techniques indicated and test drilling later confirmed that the source of chloride in well waters was probably improperly plugged or unplugged, abandoned oil and gas exploration wells. The potential for chloride contamination of wells exists in the study area and is related to proximity to improperly abandoned oil and gas exploration wells and to gradients established by drawdowns associated with pumped wells. Periodic use of surface geophysical methods, in combination with added observation wells, could be used to monitor significant changes in groundwater quality related to chloride contamination. (USGS)
W89-08355

EVALUATION OF AVAILABLE DATA ON THE GEOHYDROLOGY, SOIL CHEMISTRY, AND GROUNDWATER CHEMISTRY OF GAS WORKS PARK AND SURROUNDING REGION, SEATTLE, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
M. A. Sabol, G. L. Turney, and G. N. Ryals.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4045, 1988. 49p, 18 fig, 1 plate, 5 tab, 14 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water pollution sources, *Geohydrology, *Water chemistry, *Toxic wastes, *Organic wastes, *Seattle, *Washington, *Polycyclic aromatic hydrocarbons, Soil chemistry, Sediments, Gasification.

Gas Works Park, in Seattle, Washington, is located at the site of an abandon gasification plant on Lake Union. Wastes deposited during 50 years of plant operations (1906-1956) have extended the shore line 100 ft and left the park soil contaminated with a number of hazardous material. Soil contaminants include polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls, pesticides, volatile organic compounds, cyanide, and metals. PAHs and metals have been detected in Lake Union sediments. Maximum total PAH concentrations exceeded 100 million micrograms/kilogram in some places in the soils of the park at 6-inch depths and in some lake sediments. Other contaminants present are much lower in concentrations. The park is on glacial drift overlain by gasification waste materials and clean fill. Waste materials include sand and gravels, mixed with lampblack, oil, bricks, and other industrial wastes. Groundwater flows through the soils and waste toward Lake Union. Vertical groundwater movement is uncertain, but is assumed to be upward near Lake Union. Concentrations of most soil contaminants are probably low in the groundwater and in Lake Union due to the low solubilities and high sorptive characteristics of these contaminants. However, no water quality data are available to confirm this premise. (USGS)
W89-08356

SIMULATION OF QUANTITY AND QUALITY OF STORM RUNOFF FOR URBAN CATCHMENTS IN FRESNO, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
J. R. Guay, and P. E. Smith.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4125, 1988. 76p, 28 fig, 18 tab, 26 ref.

Descriptors: *Fresno, *California, *Model studies, *Water quality, *Urban runoff, *Hydrologic models, *Urban hydrology, *Storm runoff, Drainage engineering, Storm waste water, Water quality management, Discharge hydrographs.

Rainfall-runoff models were developed for a multiple-dwelling residential catchment (2 applications), a single-dwelling residential catchment, and a commercial catchment in Fresno, California, using the U.S. Geological Survey Distributed Routing Rainfall-Runoff Model (DR3M-II). A runoff-quality model also was developed at the commercial catchment using the Survey's Multiple-Event Urban Runoff Quality model (DR3M-qual). The purpose of this study was: (1) to demonstrate the capabilites of the two models for use in designing storm drains, estimating the frequency of storm runoff loads, and evaluating the effectiveness of street sweeping on an urban drainage catchment; and (2) to determine the simulation accuracies of these models. Simulation errors of the two models were summarized as the median absolute deviation in percent (mad) between measured and simulated values. Calibration and verification mad errors for runoff volumes and peak discharges ranged from 14 to 20%. The estimated annual storm-runoff loads, in pounds/acre of effective impervious area, that could occur once every hundred years at the commercial catchment was 95 for dissolved solids, 1.6 for the dissolved nitrite plus nitrate, 0.31 for total recoverable lead, and 120 for suspended sediment. Calibration and verification mad errors for the above constituents ranged from 11 to 54%. (USGS)
W89-08359

U.S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1985-86,
Geological Survey, Rapid City, SD. Water Resources Div.
K. E. Goddard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-484, 1988. 158p, 13 fig, 58 tab, K. E. Goddard, ed.

Descriptors: *Mine wastes, *South Dakota, *Water pollution sources, *Data collections, *Hydrologic data, *Water quality, Biology, Sediment chemistry, Adsorption-desorption, Water analysis.

The Cheyenne River system in Western South Dakota has been impacted by the discharge of about 100 million metric tons of gold-mill tailings to Whitewood Creek near Lead, South Dakota. In April 1985, the U.S. Geological Survey initiated an extensive series of research studies to investigate the magnitude of the impact and to define important processes acting on the contaminated sediments present in the system. The report presents all data collected during the 1985 and 1986 water years for these research studies. Some of the data included have been published previously. Hydrologic, geochemical, and biologic data are available for sites on Whitewood Creek, the Belle Fourche and Cheyenne Rivers, and for the Cheyenne River arm of Lake Oahe. Data complexity varies from routine discharge and water quality to very complex photon-correlation spectroscopy and energy-dispersive x-ray analysis. Methods for sample collection, handling and preservation, and laboratory analysis are also presented. No interpretations or complex statistical summaries are included. (USGS)
W89-08360

GEOSTATISTICAL INTERPOLATION OF HYDROSTRATIGRAPHY AT GROUNDWATER CONTAMINATION SITES,
California Univ., Santa Cruz. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W89-08370

COAL SPOIL AND GROUNDWATER CHEMICAL DATA FROM TWO COAL MINES; HANNA BASIN AND POWDER RIVER BASIN, WYOMING,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08386

HYDROGEOCHEMICAL DATA FROM AN ACIDIC DEPOSITION STUDY AT MCDONALDS BRANCH BASIN IN THE NEW JERSEY PINELANDS, 1983-86,
Geological Survey, Trenton, NJ. Water Resources Div.
D. G. Lord, J. L. Barringer, P. A. Johnsson, P. F. Schuster, and R. L. Walker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-500, (1988). 18 fig, 24 tab, 62 ref.

Descriptors: *Acid rain, *Water quality.

This report presents data from a 1983-86 acidic-deposition study at McDonalds Branch basin, a small (2.35 sq mi) forested watershed in Lebanon State Forest, New Jersey. These data include soil and clay deposit mineralogy; physical and chemical analyses of soils; hydrologic measurements (precipitation and throughfall amounts, stream stage and discharge, and water table altitudes); and water quality data from precipitation, throughfall, soil water, surface water, and groundwater. Site locations, collector designs, and well-construction data are also presented. The pH of bulk precipitation to McDonalds Branch basin over the sampling period (January 1985 to March 1986) ranged from 4.0 to 4.7 with a mean of approximately 4.3. Stream pH ranged from 3.2 to 4.8 and generally increased in a downstream direction. In general, sulfate was the dominant anion throughout the basin. Aluminum concentrations commonly were elevated in surface and groundwaters, and were as high as 10,000 mg/L at one upstream site on McDonalds Branch. Dissolved organic carbon was an important component of stream waters in some locations and ranged in concentration from 1.1 to 37 mg/L. (USGS)
W89-08392

SELECTED WATER QUALITY DATA FOR THE FORT HALL INDIAN RESERVATION, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
D. J. Parliman, and H. W. Young.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-496, 1988. 1 sheet, 3 fig, 2 tab, 1 ref.

Descriptors: *Water quality, *Nitrogen compounds, *Drinking water, *Groundwater pollution, Groundwater level, Nitrate, Idaho, Snake River Plain, Fort Hall Indian Reservation.

This report presents July 1988 water quality data, principally dissolved nitrite plus nitrate (as nitrogen), and depth-to-water measurements for 60 wells in the Fort Hall Indian Reservation north of Pocatello, southeastern Idaho. Nitrogen concentrations ranged from 0.7 to 24 mg/L; the median concentration was 3.1 mg/L. Nitrogen concentrations in 11 samples exceeded the U. S. Environmental Protection Agency public drinking water limit of 10 mg/L. (USGS)
W89-08395

EXTENSION OF STREAMFLOW AND DISSOLVED-SOLIDS RECORDS AT SELECTED SITES IN THE COLORADO RIVER BASIN, ARIZONA, CALIFORNIA, COLORADO, NEVADA, NEW MEXICO, UTAH, AND WYOMING, 1940-85,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08398

FIELD AND LABORATORY DATA DESCRIBING PHYSICAL AND CHEMICAL CHARACTERISTICS OF METAL-CONTAMINATED FLOOD-PLAIN DEPOSITS DOWNSTREAM FROM LEAD, WEST-CENTRAL SOUTH DAKOTA,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. C. Marron.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 88-349, 1988. 32p, 5 fig, 11 tab, 7 ref.

Descriptors: *Water pollution sources, *Flood plain sediments, *Path of pollutants, *Arsenic, *Heavy metals, *Mine wastes, *South Dakota, Flood plains, Overbank deposits.

Samples from metal-contaminated flood-plain sediments at 9 sites downstream from Lead, in west-central South Dakota, were collected during the summers of 1985-87 to characterize aspects of the sedimentology, chemistry, and geometry of a deposit that resulted from the discharge of a large volume of mining wastes into a river system. Field and laboratory data include stratigraphic descriptions, chemical contents and grain-size distributions of samples, and surveyed flood-plain positions of samples. This report describes sampling-site locations, and methods of sample collection and preservation, and subsequent laboratory analysis. Field and laboratory data are presented in 4 figures and 11 tables in the 'Supplemental Data' section at the back of the report. (USGS)
W89-08405

SOIL-WATER HYDROLOGY AND GEOCHEMISTRY OF A COAL SPOIL AT A RECLAIMED SURFACE MINE IN ROUTT COUNTY, COLORADO,
R. S. Williams, and S. E. Hammond.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 86-4350, 1989. 100p, 25 fig, 24 tab, 66 ref.

Descriptors: *Monitoring, *Groundwater pollution, *Acid mine drainage, *Colorado, *Strip mines, *Coal spoil, *Geochemistry, Leaching, Weathering, Soil water, Coal.

Coal-spoil water quantity and quality were monitored in Routt County, Colorado by five drainage-type lysimeters installed in a reclaimed coal spoil. Soil water access tubes were used to monitor soil-water content at the coal spoil and at an adjacent undisturbed area. Results of the monitoring indicate that the undisturbed soils are nearly saturated at 4.5 to 5 ft. Coal spoils are not near saturation at similar depths. Normal recharge in a nearby unmined area is estimated to be about 0.5 in/year. At a depth of 8 ft, 2 to 6 inches of water/unit surface area is percolating through the coal spoil in the lysimeters. The water is potential recharge to a coal-spoil aquifer. The coal-spoil leachate has an average dissolved-solids concentration of 3,600 mg/L. Calcium (460 mg/L), magnesium (370 mg/L), and sulfate (2,540 mg/L) are the dominant ions in the leachate; sodium (111 mg/L) and bicarbonate (224 mg/L) are present in lesser concentrations. Gypsum dissolution and carbonate dissolution by carbonic acid from carbon dioxide and by sulfuric acid from pyrite oxidation account for most of the dissolved-solids concentration. Saturation indices indicate that the water is saturated with many minerals and is composed of the aforementioned ions. (USGS)
W89-08413

DIRECT-CURRENT RESISTIVITY DATA FROM 94 SITES IN NORTHEASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Stuart, FL. Water Resources Div.
C. J. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-464, 1988. 101p, 2 fig, 15 ref.

Descriptors: *Resistivity, *Electrical studies, *Florida, *Geophysics, *Palm Beach County, *Saline water intrusion, Water quality, Groundwater pollution, Path of pollutants.

Direct-current resistivity data were collected from 94 vertical electric sounding profiles in northeastern Palm Beach County, Florida. Direct-current resistivity data, which may be used to determine locations and thicknesses of shallow, semi-permeable marls or locate zones of high chloride concentration, are presented in this report. The resistivity data consist of field data, smoothed data, layer resistivity from smoothed data, and Cartesian graphs of resistivity in relation to depth for 94 sites located in northeastern Palm Beach County. (USGS)
W89-08415

EFFECTS OF TREATED MUNICIPAL EFFLUENT IRRIGATION ON GROUNDWATER BENEATH SPRAYFIELDS, TALLAHASSEE, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-08421

HYDROGEOLOGIC EVALUATION OF A SAND AND GRAVEL AQUIFER CONTAMINATED BY WOOD-PRESERVING COMPOUNDS, PENSACOLA, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. J. Franks.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4260, 1988. 72p, 44 fig, 4 tab, 32 ref.

Descriptors: *Geohydrology, *Water pollution sources, *Groundwater pollution, *Creosote, Florida, Pensacola, Groundwater hydrology.

The sand and gravel aquifer in southern Escambia County, Florida, is a typical surficial aquifer composed of quartz sands and gravels interbedded locally with silts and clays. Problems of groundwater contamination from leaking surface impoundments are common in surficial aquifers and are a subject of increasing concern and attention.

A potentially widespread contamination problem involves organic chemicals from wood-preserving processes. Because creosote is the most extensively used industrial preservative in the United States, an abandoned wood-treatment plant near Pensacola was chosen for investigation. This report describes the hydrogeology and groundwater flow system of the sand and gravel aquifer near the plant. A three-dimensional simulation of groundwater flow in the aquifer was evaluated under steady-state conditions. The model was calibrated on the basis of observed water levels from January 1986. Calibration criteria included reproducing all water levels within the accuracy of the data (one-half contour interval in most cases). Sensitivity analysis showed that the simulations were most sensitive to recharge and vertical leakance of the confining units between layers 1 and 2, and relatively insensitive to changes in hydraulic conductivity and transmissivity and to other changes in vertical leakance. Applications of the results of the calibrated flow model in evaluation of solute transport may require further discretization of the contaminated area, including more sublayers, than were needed for calibration of the groundwater flow system itself. (USGS)
W89-08422

LAND USE, WATER USE, STREAMFLOW, AND WATER QUALITY CHARACTERISTICS OF THE CHARLOTTE HARBOR INFLOW AREA, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08424

MODELS, DATA AVAILABLE, AND DATA REQUIREMENTS FOR ESTIMATING THE EFFECTS OF INJECTING SALTWATER INTO DISPOSAL WELLS IN THE GREATER ALTAMONT-BLUEBELL OIL AND GAS FIELD, NORTHERN UINTA BASIN, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Freethey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-475, 1988. 30p, 8 fig, 4 tab, 17 ref. USGS project UT182.

Descriptors: *Utah, *Model studies, *Path of pollutants, *Groundwater pollution, *Uinta Basin, *Disposal wells, *Saline water, *Groundwater quality, Aquifer characteristics, Flow modeling, Transport modeling, Oil fields.

Permits for disposing of salty oil-production water have been issued for 19 wells in the Greater Altamont-Bluebell field, Utah. During 1986 more than 500 million gal of production water were injected into the Duchesne River, the Uinta, and the Green River Formations through 18 of these wells. The physical and chemical effects of injecting this water on aquifers containing potable water are poorly understood. Interfingering and the structural configuration of these formations add complexity to the description of the geometry and hydrogeology of the groundwater system. A preliminary assessment of the problem indicates that numerical modeling may offer a method of estimating the hydrologic and hydrochemical effects of injection. Modeling possibilities include variable-density, three-dimensional flow, sectional transport, and areal transport modeling. Data needed to develop these models can be derived from a synthesis of geologic, hydrologic, and hydrochemical data already available in the files of State and Federal agencies, oil companies, and private data-base companies. Results from each modeling phase would contribute information for implementing the following phase. The result would be a better understanding of how water moves naturally through the groundwater system, the extent of alterations of both vertical and horizontal flow near the disposal wells, and an overall concept of the effects of deep injection on near-surface aquifers. (USGS)
W89-08425

IN-SITU CONTROL OF GROUNDWATER CONTAMINATION BY MICROBIOLOGICAL PROCESSES,
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
W. G. Characklis, A. B. Cunningham, and E. J. Bouwer.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148464/AS, price codes: A06 in paper copy, A01 in microfiche. Final Report, December 20, 1988. 104p, 39 fig, 5 tab, 38 ref, 3 append. USGS contract 14-08-0001-61284.

Descriptors: *Biodegradation, *Microbial transport, *Groundwater pollution, *Microbial degradation, *Organic matter, *Porous media, *Path of pollutants, Biofilm accumulation, Biofouling, Mass transport, Pore velocity, Dispersitivity, Surface roughness.

Processes governing accumulation in porous media flow are discussed along with their relationship to biotransformation of organic contaminants in groundwater. The rates of biofilm accumulation and biotransformation are strongly influenced by transport characteristics including pore velocity distribution, dispersivity, molecular diffusivity, surface roughness and other variables which affect the delivery rate of substrate and nutrients to the growing cells. Transformation rates are further affected if biomass accumulation becomes so large as to alter porous media transport characteristics. Thus, the processes of subsurface mass transport, biotransformation, and biofilm accumulation are highly interrelated. This report demonstrates these interrelationships by discussing fundamental concepts and results from laboratory and field investigations related to analysis and mitigation of porous media biofouling and in situ biodegradation of organic groundwater contaminants. (USGS)
W89-08432

HAZARDOUS ORGANIC WASTE FROM NATURAL GAS PRODUCTS PROCESSING AND DISTRIBUTION: ENVIRONMENTAL FATES,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. A. Eiceman.
Available from National Techincal Information Service, Springfield, VA 22161 as PB89-113948, price codes: A05 in paper copy, A01 in Microfiche. New Mexico Resources Research Institute, Las Cruces, Technical Completion Report No. 227, November 1986. 87p, 33 fig, 14 tab, 79 ref. USGS state project 1345630.

Descriptors: *Hydrocarbons, *Natural gas, *Groundwater pollution, *Organic wastes, *Fate of pollutants, *Wastewater disposal, Water pollution sources, Land disposal, Polycyclic aromatic hydrocarbons, Benzene, Toluene, Xylenes, Unlined waste pits, New Mexico, Duncan Oil Field.

Hydrocarbons and polycyclic aromatic hydrocarbons are generated as waste fluids and solids throughout all aspects of natural gas production, processing, and distribution. Wastes have often been and continue to be disposed in earthen unlined waste pits sometimes near vulnerable aquifers. Wastes move from pits through soils with no apparent abatement to depths greater than roughly 2 m. As expected, groundwater contamination does occur in river flood plains where depth to groundwater can be less than 2 m. Contamination of groundwater and nearby soils with hydrocarbons from an unlined pit was documented in the Duncan Oil Field west of Farmington, NM. Plumes for volatile compounds including benzene, toluene, and xylenes in the water and polycyclic aromatic hydrocarbons in the soil were clearly evident downgradient from the earthen pit at distances up to 50 m. Waste pits containing produced water and hydrostatic discharge water were found to contain large amount of polycyclic aromatic hydrocarbons which are phototoxic to fish. Legal or illegal discharges of natural gas waters to surface water should be reconsidered using not only salt and heavy metal contamination but also using toxicity and mutagenicity of aromatic hydrocarbon. (USGS)
W89-08439

INVESTIGATION OF THE TRANSPORT AND FATE OF GASOLINE HYDROCARBON POLLUTANTS IN GROUNDWATER,
Orange County Water District, Fountain Valley, CA.
H. Ridgeway, P. L. McCarty, M. Reinhard, D. W. Phipps, and J. Safarik.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-151450/AS, price codes: A19 in paper copy, A01 in microfiche. Final Report, (1989). 409p, 134 fig, 24 tab, 116 ref. USGS contract 14-08-0001-G1126.

Descriptors: *Groundwater pollution, *Microbial degradation, *Gasoline, Hydrocarbons, Path of pollutants, Fate of pollutants, Gas chromatography, Pollutant identification, Aerobic bacteria, Metabolism, Toluene, Anerobic conditions.

Groundwater and aquifer solids from a shallow, semi-perched zone of silty/sand alluvial deposits contaminated by 20 to 30 thousand liters of regular, unleaded gasoline were analyzed. Gasoline migration and an enrichment of naphthalene and p/m-xylene near the periphery of the plume were determined by gas chromatographic analyses. Gasoline-degrading bacteria from the site were sorted into 111 distinct subpopulations on a battery of 15 specific hydrocarbons representing the major chemical groups in the gasoline. Each of the 15 test hydrocarbons supported the growth of at least one bacterial isolate. 287 isolates capable of gasoline degradation were sorted into 59 distinct bacterial subpopulations. The heterogeneity of the microbial community was demonstrated by a computer programmed analysis of whole cell protein banding patterns. The aerobic, gasoline-degrading bacteria in the groundwater varied in number from one to several hundred colony forming units/ml and inversely with the hydrocarbon toulene. Exposure of the bacteria to gasoline vapors caused physiological injury, accelerated death and segregation of mutant, non-degrading strains. Metabolism of one or more specific hydrocarbons was required for the full microbicidal activity of the gasoline. Biotransformation and/or complete mineralization of selected aromatic gasoline constituents (e.g., toluene and p-xylene) was demonstrated under anaerobic (denitrifying or methanogenic) conditions. (USGS)
W89-08440

FACTORS AFFECTING LEACHING IN AGRICULTURAL AREAS AND AN ASSESSMENT OF AGRICULTURAL CHEMICALS IN THE GROUNDWATER OF KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry, F. V. Robbins, and P. L. Barnes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $9.00, microfiche $4.00. USGS Water-Resources Investigations Report 88-4104, December 1988. 55p, 9 fig, 18 tab, 40 ref. USGS project KS145.

Descriptors: *Pesticides, *Agricultural chemicals, *Groundwater pollution, *Water quality, *Kansas, Nonpoint pollution sources, Herbicides.

As assessment of hydrologic factors and agricultural practices that may affect the leaching of agricultural chemicals to groundwater was conducted to evaluate the extent and severity of chemical contamination of groundwater resources in Kansas. The climate of a particular area determines the length of the growing season and the availability of water, at the surface and in the ground, for the growth of plants. Climate, together with surficial geology, soil, and principal aquifers, determines the types of crops to be planted,types of tillage, conservation and irrigation practices, and affects the quantity and method of application of agricultural chemicals. Examination of groundwater nitrate-nitrogen data collected from 766 wells throughout Kansas during 1976-81 indicated that 13 of 14 geohydrologic regions had wells producing samples that exceeded the 10-mg/L drinking water standard determined by the U.S. Environmental Protection Agency. One or more herbicides were detected in water samples from 11 of 56 wells

during 1985-86 located in areas susceptible to agricultural leaching. Atrazine was the most common herbicide that was detected; it was detected in water at 9 of 11 wells. Cyanazine was detected in water at three wells; metolachlor at two wells; and metribuzin, alachlor, simazine, and propazine were detected at one well each. (USGS)
W89-08451

HYDROGEOLOGIC SETTING, WATER LEVELS, AND QUALITY OF WATER FROM SUPPLY WELLS AT THE U.S. MARINE CORPS AIR STATION CHERRY POINT, NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
O. B. Lloyd, and C. C. Daniel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4034, 1988. 165p, 16 fig, 8 tab, 36 ref.

Descriptors: *Geohydrology, *Path of pollutants, *Hazardous wastes, *Castle Hayne aquifer, *North Carolina, *Groundwater pollution, *Groundwater level, Cherry Point, Landfills.

The Marine Corps Air Station is located in the Coastal Plain province of North Carolina. Four freshwater aquifers of sand and limestone underlie the area to a depth of about 500 ft. Saline water occurs below this depth. The aquifers are separated by three confining units that are thin and discontinuous in the southern part. Water supply is obtained from 195- to 330 ft wells in the Castle Hayne aquifer. Many wells are near landfills that have received hazardous wastes. Groundwater withdrawals have reduced hydraulic heads in the Castle Hayne some 20 ft around active production wells, creating potential for downward movement of contaminated water from the surface and for upward movement of saline water that occurs at depth. Chemical analyses of water from the Castle Hayne aquifer indicate median concentrations of iron and manganese are 0.78 and 0.08 mg/L, respectively, and lead and (or) nickel exceed drinking water standards in three wells. Chloride increased from 10 to more than 40 mg/L in the deepest operating well over a 45-year period. Benzene concentrations range from 0.5 to 1.9 mg/L in the southern part of the Air Station but were below the 5 mg/L maximum contaminant level for drinking water. Fatty acids were found in concentrations as much as 28 microg/L in water from wells in an area centered around the intersection of Roosevelt Boulevard and Slocum Road. Resampling is needed to verify all constituents that indicate contamination. (USGS)
W89-08457

SEDIMENTATION AND WATER QUALITY IN WEST BRANCH SHADE RIVER BASIN, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress, and R. L. Jones.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $9.25, microfiche $4.00. USGS Water-Resources Investigations Report 87-4262, 1988. 56p, 8 fig, 7 tab, 21 ref.

Descriptors: *Ohio, *Strip mines, *Land reclamation, *Water quality, *Hydrologic data collections, *Coal mine effects, Cross sections, West Shade River basin.

The effects of abandoned-mine lands and their reclamation on suspended sediment, channel cross-section profile, and water quality were measured on West Branch Shade River, Ohio. During the period of study, mean suspended-sediment concentration was unchanged for West Branch Shade River near Burlingham, where 48% of the abandoned mines were reclaimed by the end of 1984. Mean suspended-sediment concentration at West Branch Shade River near Harrisonville, which was 100% reclaimed by the end of 1984, decreased from 8.6 tons/acre ft of runoff in 1984 to 0.15 in 1985. Channel profiles indicated West Branch Shade River near Harrisonville was scouring, whereas West Branch Shade River near Burlingham was filling. The greatest change in water quality during the study period was observed in West Branch Shade River near Harrisonville, where pH increased to neutral, alkalinity concentration increased, and acidity concentration decreased. (USGS)
W89-08460

STATISTICAL SUMMARY OF SELECTED WATER QUALITY DATA (WATER YEARS 1975 THROUGH 1985) FOR ARKANSAS RIVERS AND STREAMS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Petersen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4112, November 1988. 189p, 3 fig, 46 ref.

Descriptors: *Water quality, *Statistical analysis, *Surface water, *Arkansas, Rivers, Streams, Nutrients, Metals, Ions, Bacteria, Oxygen, Regression analysis.

Descriptive statistics were calculated for selected water quality data for 116 water quality stations on Arkansas rivers and streams. Water quality properties summarized included pH, specific conductance, dissolved oxygen, total alkalinity, total hardness, common dissolved constituents, phosphorus, nitrogen, biochemical oxygen demand, bacteria, turbidity, suspended sediment, and several trace metals. Regression equations and related statistics describing the relation between specific conductance and total alkalinity and several dissolved constituents also were calculated. Typical water quality (based upon median values at individual stations) of physiographic sections and major rivers of Arkansas also is discussed. Discernible differences in water quality exist between sections and major rivers. The regression analysis indicated that the usefulness of specific conductance as a predictor of other water quality values is variable. The relation between specific conductance and the other property is not statistically significant ($p>0.05$) about 30% of the time. (USGS)
W89-08461

PRELIMINARY EVALUATION OF GROUNDWATER FLOW IN BEAR CREEK VALLEY, THE OAK RIDGE RESERVATION, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
Z. C. Bailey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4010, November 1988. 12p, 6 fig, 1 tab, 14 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Hazardous wastes, *Tennessee, Oak Ridge, Bear Creek Valley, Model studies.

Bear Creek Valley, Tennessee contains hazardous waste disposal sites where contaminants leach into ground and surface water. Groundwater flow and the potential migration of contaminants is poorly understood. The Valley is underlain by calcareous shale that contains limestone units. Ridges to the north and south are underlain by interbedded sandstones, siltstone and shale, and by massive, siliceous dolomite, respectively. The bedrock, which dips about 45 degrees southeast, is overlain by regolith to a maximum thickness of 80 ft. Observed hydraulic conductivities for the regolith range from 0.01 to 13 ft/day, and for the bedrock, from 0.001 to 11 ft/day. Groundwater flow is probably toward streams and is preferential along strike because of an areal anisotropy in hydraulic conductivity. A cross sectional groundwater flow model was used to test the conceptualized flow system and to help identify areas where additional data are needed. The preliminary model shows a pattern of recharge at both ridges, flow toward the valley, and upward flow that discharges into Bear Creek. Final model values of hydraulic conductivity in the bedrock range from 0.01 to 0.1 ft/day and reflect an areal anisotropy ratio of 1:5. Simulated recharge was 10 inches/year. (USGS)
W89-08463

SUPERFUND RECORD OF DECISION: POWERSVILLE L.F., GA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5D.
W89-08472

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 3: ENVIRONMENTAL SULPHUR ISOTOPE STUDIES IN ALBERTA: A REVIEW,
Calgary Univ. (Alberta). Dept. of Physics.
H. R. Krouse.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-143458. Price codes: E05 in paper copy, A01 in microfiche. February 1987. 89p, 31 fig, 2 tab, 175 ref.

Descriptors: *Air pollution effects, *Isotope studies, *Literature review, *Acid rain, *Sulfur compounds, *Path of pollutants, *Alberta, Fate of pollutants, Oxygen, Microbial degradation.

Environmental sulfur isotope studies have been conducted in Alberta since the late 1960's. To date, thousands of analyses have been carried out for sulfur compounds or extracts from the atmosphere, hydrosphere, pedosphere, and biosphere. Basic principles of stable isotopes which pertain to sulfur pollution include the following: (1) Isotopes of an element differ in their masses. Since many processes are mass dependent, the relative abundances (the ratio of the number of 34-S atoms to 33-S atoms) in natural components are altered; (2) The process which alters sulfur isotope abundances most significantly is bacterial SO4(2-) reduction during which 33-SO4(2-) is converted faster than 34-SO4(2-) to sulfide; (3) Because of the above, pollutants usually differ in isotopic composition from their environmental receptors; (4) Successful isotope tracing of pollutant sulfur requires minimal isotope fractionation during transport and deposition; (5) Since the uniform composition of O2 in the atmosphere differs greatly from the variable isotopic composition of water, oxygen isotope measurements on sulfate provide information concerning the oxidation of pollutant sulfur. (See W89-08489 thru W89-08492) (Lantz-PTT)
W89-08488

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 4: CRITICAL REVIEW OF INORGANIC SULPHUR MICROBIOLOGY WITH PARTICULAR REFERENCE TO ALBERTA SOILS,
Calgary Univ. (Alberta). Dept. of Biology.
E. J. Laishley, and R. Bryant.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-143466. Price codes: E04 in paper copy, A01 in microfiche. February 1987. 50p, 7 fig, 5 tab, 150 ref.

Descriptors: *Air pollution effects, *Literature review, *Alberta, *Path of pollutants, *Acid rain, *Sulfur, *Microbiological studies, *Sulfur bacteria, *Soil contamination, Soil fungi, Soil bacteria, Oxidation, Chemical reactions, Acidification, Lime.

The physiology and biochemistry of the microorganisms participating in the sulfur cycle are discussed. Of particular importance to the Alberta situation are the sulfur oxidizing microorganisms belonging to the Colorless Sulfur Bacteria' group, with special reference to the thiobacilli. New species of the thiobacilli native to Alberta have been isolated and characterized; their biological properties are compared to other known species. Biological oxidation of inorganic sulfur can have economic and ecological repercussions, such as: creation of acid soils, with accompanying leaching of nutrients such as Fe(2+) and Al(3+) resulting in toxicity to plants; and acid production causing direct damage to plant tissues. Three main factors affecting the oxidation of fugitive (wind blown) sulfur include the sulfur itself, the sulfur oxidizing microorganisms, and the soil environment. With regard to the sulfur itself, its microcrystalline structure

and particle size affect the biological oxidation rate. Different sulfur microorganisms can oxidize sulfur at different rates. The microbial oxidation of sulfur in the soil is markedly affected by temperature, moisture and nutrients, and soil type. Fugitive sulfur from existing stock piles or drilling operations create an ideal soil environment for the sulfur oxidizing thiobacilli, possibly resulting in the acidification of the soil. Long term studies of SO2 contamination of soils from a nearby gas plant did not show acidification trends, suggesting that acidification of soils from SO2 deposition is not as severe as wind blown sulfur dust contamination. Liming an acid soil polluted with sulfur only masks an existing problem and really provides a more favorable environment for continued microbial sulfur oxidation and acidification. (See W89-08487 thru W89-08488 and W89-08490 thru W89-08492) (Lantz-PTT)
W89-08489

COMPOSITE, MESO-GAMMA SCALE DIAGNOSTIC MODELING,
Battelle Pacific Northwest Labs., Richland, WA.
R. C. Easter, and C. G. Lindsey.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-008189, price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--15692, February 1988. 8p, 3 fig, 1 tab, 2 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Acid rain, *Model studies, *Path of pollutants, *Clouds, *Precipitation, Meteorology, Fate of pollutants, Chemistry of precipitation, Chemical reactions.

Diagnostic modeling using data from analyses of Processing of Emissions by Clouds and Precipitation (PRECP) field experiments and from more extensive theoretical studies provides an understanding of pollutant processing resulting from the combined effects of vertical transport, physical transport, and cloud chemistry processes. The tasks of generalizing the results of a necessarily limited number of case studies and then incorporating these results into simpler wet-removal modules will require much cooperation between diagnostic and regional modelers. (Lantz-PTT)
W89-08499

WESTERN LAKE SURVEY, PHASE I. CHARACTERISTICS OF LAKES IN THE WESTERN UNITED STATES: VOLUME II. DATA COMPENDIUM FOR SELECTED PHYSICAL AND CHEMICAL VARIABLES,
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
J. M. Eilers, P. Kanciruk, R. A. McCord, W. S. Overton, and L. Hook.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-1146832. Price codes: A22 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/054b, January 1987. 493p, 173 fig, 10 tab. EPA Contracts 68-03-3249, 68-01-7288, 68-02-3994, 68-03-3246, and 40-1441-84.

Descriptors: *Acidification, *Acid rain effects, *Lakes, *Surveys, *Data collections, Chemical analysis, Physical properties, Hydrogen ion concentration, Sulfates, Calcium, Aluminum, Organic carbon, Maps, Lake morphology.

The Western Lake Survey-Phase I (WLS-I) was designed to provide the information needed to assess the chemical status of lakes in areas of the western U.S. containing the majority of low alkalinity systems. Lakes were selected statistically from the population of lakes within five western mountainous regions: California, the Pacific Northwest, the Northern Rockies, the Central Rockies, and the Southern Rockies. Variables thought to influence or be influenced by surface water acidification were measured using standardized methods. The primary objectives of the WLS-I were to: (1) determine the percentage (by number and area) and location of lakes that are acidic in potentially sensitive areas of the western United States; (2) determine the percentage (by number and area) and location of lakes that have low acid neutralizing capacity in potentially sensitive areas of the western U.S.; and (3) determine the chemical characteristics of lake populations in potentially sensitive areas of the western U.S. and provide a data base for selecting lakes for future studies. This volume of the report is presented as five sections: (1) an introduction; (2) population estimates for selected physical and chemical variables. The reference values and population estimates pertaining to these values are provided for the six primary variables: acid neutralizing capacity, pH, sulfate, calcium, extractable aluminum, and dissolved organic carbon. No reference values for the physical variables or the secondary variables are given; (3) list the U.S. Geological Survey maps used to defined the map population and identify non-target lakes; (4) maps showing the locations of sampled lakes within each of the ten states sampled; and (5) data for individual sample lakes and special interest lakes. Lists of lakes sorted by state and lake name and by lake ID are provided. (Lantz-PTT)
W89-08500

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 1: SURFACE WATER ACIDIFICATION LITERATURE REVIEW,
Acid Deposition Research Program, Calgary (Alberta).
S. A. Telang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-143433, price codes: E06 in paper copy, A01 in microfiche. 123p, 7 fig, 6 tab, 238 ref, append.

Descriptors: *Acid rain effects, *Surface water, *Literature review, *Water pollution sources, *Alberta, *Acidification, Chemistry of precipitation, Acidic water, Water pollution effects, Model studies.

The objective was to analyze the present state of knowledge on relationships between acid deposition and surface water acidification, with reference to chemical criteria that have been used to evaluate surface water acidification. To achieve this objective, the report provides brief background information on precipitation chemistry and the manner by which acidity of precipitation and surface waters is measured. It also provides information on why some waters are sensitive to acidification and others are not. After briefly describing reactions of hydrogen ions in aquatic and terrestrial systems, the author addresses whether: (1) factors of quantity and quality of precipitation and episodic events affect the process of acidification of surface waters; (2) surface water acidification occurs by anthropogenic or natural input of hydrogen ions; and (3) watershed characteristics influence surface water susceptibility to acidification. The report also includes a section describing acidification studies in North America with particular reference to Alberta, a section discussing acidification effects on aquatic biota, a summary of models that have been used in surface water acidification studies, and a list of recommendations for studies in Alberta. (Lantz-PTT)
W89-08504

INITIAL EVALUATION OF PHOTOGRAPHIC DATA OF F- AND H-AREA SEEPAGE BASIN OUTCROPS,
Savannah River Lab., Aiken, SC. Environmental Sciences Div.
H. E. Mackey.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-007608, price codes: A02 in paper copy, A01 in microfiche. Report No. DPST-88-314, February 8, 1988. 7p, 3 tab, append. DOE Contract DE-AC09-76SR00001.

Descriptors: *Path of pollutants, *Water pollution effects, *Radioactive waste disposal, *Seepage, *Outcrops, *Ecological effects, Surface waters, Aerial photography, Data interpretation, Photography, Vegetation, Trees, Water resources development.

Photographic data for the Savannah River Plant (SRP) were reviewed from 1961 through 1987 to determine the value of this photography in estimating the timing and extent of the F- and H-Area seepage basin outcrops along the upper Four Mile Creek floodplain. In excess of 15,000 frames of photography of the SRP were reviewed. The quality of the photography varied widely and included panchromatic (black and white), natural color, and false color infrared. Altitudes of the photography ranged from 2,000 ft above ground level (AGL) to 40,000 ft AGL. For each year the best photography at the lowest altitude was evaluated to determine the presence of vegetation damage downslope of the F- and H-Area seepage basins. A stereoscope was used to view overlapping stereopairs of photographs where these were available. Criteria of: (1) no visible evidence of vegetation (forest canopy) damage, (2) initial evidence of vegetation or canopy damage, (3) canopy thinning, (4) tree mortality, and (5) expansion of vegetation damage and/or tree mortality zones were applied to each of the photographs. For both the F- and H-Area seepage basin outcrops, visible effects (initial, canopy thinning, and tree mortality) were observed in the September 1980, natural color photography of the Four Mile Creek area. No evidence was observed in the March 1979 Forest Service photography indicating that the vegetation changes occurred in 1979 or 1980. Expansion of both areas (especially the H-Area outcrop) has been observed in photography from 1980 through 1987. These outcrops have also been confirmed in the airborne multispectral scanner (MSS) data for the spring of 1982, 1985, 1986, and 1987, and in SPOT satellite MSS data for April and October 1987. (Lantz-PTT)
W89-08506

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 1. OVERVIEW OF THE EMISSION DATA: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
D. J. Picard, D. G. Colley, and D. H. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-143391 price codes: E04 in paper copy, A01 in microfiche. November 1987. 87p, 12 fig, 58 tab, 14 ref, 4 append.

Descriptors: *Alberta, *Acid rain, *Sulfur oxides, *Nitrogen oxides, *Water pollution sources, Classification, Monitoring, Water pollution prevention, Air pollution, Surveys, Computers.

It has been recognized that with acid-forming emissions (i.e., sulfur dioxide and nitrogen oxides) existing inventories for Alberta are either incomplete or do not provide sufficient detail to permit the investigation of specific regions within the province. Therefore, as part of the Alberta Government/Industry Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed: a sulfur dioxide (SO2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air quality monitoring stations. The basic objectives in developing these three inventories have been: (1) to identify all noteworthy anthropogenic sources of SO2 and NOx emissions in Alberta; (2) to characterize each emission source, as appropriate, with respect to type of emission, geographic location, environmental setting, physical characteristics, maximum licensed emission rate, and emission characteristics; (3) to conduct a limited NOx source sampling program in order to develop Alberta-specific NOx emission factors for natural gas fueled reciprocating and turbine engines, and to assess the importance of waste gas incinerator units as NOx emission sources; (4) to identify all air quality monitoring stations at which ambient levels of NOx and/or SO2 are measured; and (5) to computerize the inventories so that information may be easily retrieved and the inventories easily updated. This report consists of a brief summary describing development of the inventory, a summary of emissions data by emission type, geographic region, and a summary of the air quality monitoring station inventory. Conclusions and recommendations are also presented in this volume. Detailed summary tables describing emissions by major source category, petroleum industry facility type, and

source type for each geographic emission region are appended to the volume. (See W89-08508 thru W89-08510) (Lantz-PTT)
W89-08507

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 2. DESIGN OF THE EMISSION INVENTORY: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
D. J. Picard, D. G. Colley, and D. H. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-1443409 price codes: E04 in paper copy, A01 in microfiche. November 1987. 86p, 8 fig, 19 tab, 25 ref.

Descriptors: *Data collections, *Alberta, *Acid rain, *Sulfur oxides, *Nitrogen oxides, *Water pollution sources, *Monitoring, Classification, Water pollution prevention, Air pollution, Surveys, Computers.

It has been recognized that with acid-forming emissions (i.e., sulfur dioxide and nitrogen oxides) existing inventories for Alberta are either incomplete or do not provide sufficient detail to permit the investigation of specific regions within the province. Therefore, as part of the Alberta Government/Industry Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed: a sulfur dioxide (SO2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air quality monitoring stations. The basic objectives in developing these three inventories have been: (1) to identify all noteworthy anthropogenic sources of SO2 and NOx emissions in Alberta; (2) to characterize each emission source, as appropriate, with respect to type of emission, geographic location, environmental setting, physical characteristics, maximum licensed emission rate, and emission characteristics; (3) to conduct a limited NOx source sampling program in order to develop Alberta-specific NOx emission factors for natural gas fueled reciprocating and turbine engines, and to assess the importance of waste gas incinerator units as NOx emission sources; (4) to identify all air quality monitoring stations at which ambient levels of NOx and/or SO2 are measured; and (5) to computerize the inventories so that information may be easily retrieved and the inventories easily updated. This report presents information on the classification systems, source characterization, emission calculations, and data fields employed for each emission type. Details describing the source sampling program conducted as part of the NOx inventory and the computerization of the inventories are also presented in this volume. A detailed discussion of some of the major air quality monitoring networks in Alberta is included. (See W89-08507 and W89-08509 thru W89-08510) (Lantz-PTT)
W89-08508

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 3. EMISSION DATA BASE: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
D. J. Picard, D. G. Colley, and D. H. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-143417, price codes: E14 in paper copy, A01 in microfiche. November 1987. 335p, 6 fig, 7 tab, 6 ref.

Descriptors: *Data collections, *Alberta, *Acid rain, *Sulfur oxides, *Nitrogen oxides, *Water pollution sources, Classification, Monitoring, Water pollution prevention, Air pollution, Surveys, Computers.

As part of the Alberta Government/Industry, Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: sulfur dioxide (SO2) emission inventory (industrial sources), a nitrogen oxides (NOx) emission inventory (industrial, urban and highway sources), and an inventory of air quality monitoring stations (both industry and government operated stations). The three inventories are intended to serve as a source of information that will assist investigators in estimating the average rates of NOx and SO2 emission in Alberta, and the geographic distribution of these emissions. In Volume 3 a complete listing of each of the inventories is presented. (See W89-08507 thru W89-08508 and W89-08510) (Author's abstract)
W89-08509

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 4. RESULTS OF THE EMISSION SOURCE SURVEYS: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
D. J. Picard, D. G. Colley, and D. H. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-143425 price codes: E08 in paper copy, A01 in microfiche. November 1987. 203p, 104 tab, 2 ref.

Descriptors: *Water pollution sources, *Nitrogen oxides, *Sulfur oxides, *Acid rain, *Data collections, Alberta, Air pollution, Surveys, Monitoring.

To predict air quality properly at a given location at a given location, it is necessary to identify all emission sources that will have significant impact at that location. Furthermore, the atmospheric pollutants that are emitted by these sources must be identified and qualitatively characterized. Once the air quality predictions have been made, it is desirable to have some historical air quality data for comparison. An efficient means of obtaining the information is through the use of detailed emission inventories and an inventory of air quality monitoring stations. Therefore, as part of the Alberta Government/Industry Acid Deposition Research Program (ADRP), three comprehensive inventories have been developed, namely: a sulfur dioxide (SO2) emission inventory, a nitrogen oxides (NOx) emission inventory, and an inventory of air quality monitoring stations. This, volume 4, presents detailed results of the surveys conducted as part of the emissions inventory. (See W89-08507 thru W89-08509) (Author's abstract)
W89-08510

SUPERFUND RECORD OF DECISION: SCHMALZ DUMP, WI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08511

OVERVIEW OF THE PHYSICAL-CHEMICAL PROCESSES IN THE FORMATION OF ACID PRECIPITATION,
MITRE Corp., McLean, VA. Jason Program Office.
J. Chamberlain, G. MacDonald, and M. Ruderman.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-007508, price codes: A04 in paper copy, A01 in microfiche. Report No. JSR--82-301A, March 1983. 56p, 22 fig, 5 tab, 34 ref.

Descriptors: *Water chemistry, *Path of pollutants, *Acid rain, *Chemical reactions, *Water pollution sources, Nitrogen, Carbon dioxide, Nitrates, Nitrogen, Sulfur dioxide, Absorption, Sulfates, Sulfuric acid, Nitric acid, Water pollution effects, Sinks.

When coal or oil is burned efficiently, the main gaseous effluents from chimney stacks are N2, CO2, and H2O. About 1% of the flue gas consists of NOx and SO2. Within hours these gases are usually rather well mixed into the convecting layer of the atmosphere, a 'mixing layer' on the order of a kilometer thick, which covers most of the earth's land surface. The emitted NOx and SO2 have several important sinks: (1) Flow out over the oceans, with ultimate absorption by the sea; (2) Absorption by near or distant ground cover; (3) Oxidation to nitrate (NO3(-)) and sulfate (SO4(2-)) compounds which, in an atmosphere without water droplets, will coalesce to form essentially dry aerosol particles; (4) Absorption by cloud droplets before or after oxidation to sulfuric acid (H2SO4) and nitric acid (HNO3) to produce subsequent acid precipitation. (Gaseous SO2 is not efficiently scavenged by falling rain.) About 1/5 of the SO2 emitted in the Eastern U.S. (EUS) leaves the atmosphere as sulfate (mainly sulfuric acid) in acid precipitation falling upon the U.S. and Canada. Surface absorption of SO2 is probably comparable, but there are no adequate data on this important sink. Nitric acid is, a considerably smaller contributor to the acid content of rain than is sulfuric acid in the EUS, but in large part only because each SO4(2-) in aqueous H2SO4 supports two H(+), while aqueous HNO3 contributes only one for singly ionized NO3(-). Damage to many ecological systems and man-made structures may not depend sensitively upon whether sulfuric (and nitric) acid may be formed before removal from the atmosphere or from SO2 after absorption onto a surface layer. Therefore the known and potential risks from airborne SO2 might remain even if there were an 'acid rain' sink for it. (Lantz-PTT)
W89-08514

WATER QUALITY TRENDS IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien, and D. C. Grobler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-209176, price codes: E05 in paper copy, E05 in microfiche. October 31, 1986. 25p, 4 fig, 2 tab, 39 ref.

Descriptors: *Water resources management, *South Africa, *Water quality management, Water quality, Hydrologic budget, Monitoring, Water management, Eutrophication, Organic compounds, Hazardous wastes, Parasites, Bacteria, Sediments, Silt, Thermal pollution.

South Africa, as a water-limited country with a rapidly growing population, faces complex water resources management problems, including those of water quality management. Water quality is influenced by factors such as water availability, point and non-point (diffuse) sources of pollutants and in-stream or in-lake chemical/physical/biological processes. Water quality problems include mineralization, eutrophication, organic pollution, pathogens and parasites, hazardous chemical compounds, sediments (silt) and to a much lesser degree thermal pollution. (Author's abstract)
W89-08515

STORM EVENT SAMPLING OF TWO LOW ALKALINITY SOUTHWESTERN ARKANSAS STREAMS,
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
For primary bibliographic entry see Field 2E.
W89-08517

SOUTH BISCAYNE BAY WATER QUALITY: A TWELVE YEAR RECORD FOR BISCAYNE NATIONAL PARK,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
S. Nnaji.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-213715. Price codes: A04 in paper copy, A01 in microfiche. Research/Resources Management Report SER-88, December 1987. 79p, 3 fig, 15 tab, 4 ref, 2 append. National Park Service Contract CX5000-4-1102.

Descriptors: *Bays, *Data collections, *Florida, *Biscayne Bay, *Water Quality, *National Parks, Ammonia, Hydrogen ion concentration, Turbidity, Nitrates, Dissolved oxygen, Salinity, Conductivity, Statistical analysis, Correlation analysis, Water sampling.

An observational study was performed on a set of water quality data obtained from Biscayne Bay, Florida. In all, 131 sampling episodes were carried out over a period of about 12 years. Data summa-

ries of 11 variables were calculated for all of the sampling stations and the categories of sampled depths. Based on a multivariate analysis of the variances it was concluded that there is no significant variation in the sampled variables with depth. On the average, ammonium, turbidity, and dissolved oxygen were the most variable; pH and the nitrate ion were the next most variable while salinity and the conductivity were the least variable. Cluster analysis of the samples collected from 1979 to 1984 showed that there were basically two clusters of stations: those at the mouth of the canals and nearshore and those that were offshore. Further analysis of the offshore stations provided a basis for deleting some of those stations without losing valuable information on the microecosystem around the deleted station. The records of the Moody and Mowry canal discharges into the Bay were combined with the sampled bay water quality data in order to investigate the impacts of such discharges. Thresholds were assumed for the discharge and water quality variables. Because of the arbitrary choice of the thresholds, only relative inferences were made concerning the distribution of ion concentration along the axis of canal discharges. The Kendall rank correlation method was used to investigate possible trend in the data sets and to determine an optimal sampling frequency. Independence between successive observations was assumed to be established if the calculated rank score exceedance probability was > 0.05. Based on this criterion, the monthly observations were found to be independent. The calculated exceedance probability did not change significantly with increasing sampling frequency. Thus, the analyses did not indicate any trend or seasonality. This, however, may be because measurements were made just once, and in a few cases only several times in any one month. (Author's abstract)
W89-08519

ORGANIC POLLUTION OF THE WATER IN THE BLACK CREEK VICINITY, BISCAYNE NATIONAL PARK,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
E. F. Corcoran, M. S. Brown, and A. D. Freay.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-213699. Price codes: A03 in paper copy, A01 in microfiche. National Park Service Research/Resources Management Report SER-86, December 1987. 18p, 4 tab, 9 ref.

Descriptors: *Water pollution sources, *Estuarine environment, *Organic compounds, *National Parks, Black Creek, Turbidity, Ammonia, Phosphates, Salinity, Pesticides, Nutrients, Upwelling, Insecticides, Groundwater pollution, Groundwater movement, Agricultural runoff.

In June 1980 the boundaries of Biscayne National Park were extended to include Black Creek, an area that had been of ecological concern for several years. Prior to acquisition, local commercial fishermen had complained of fish kills and reduced catches and elevated water-column turbidity, ammonia and phosphate concentrations, and lower salinities as compared to other canals in lower Biscayne Bay and Card Sound were reported. As a result of these concerns, the National Park Service funded a study to investigate the possible causes of several of the changes that were taking place in the Black Creek area. The objectives were to document benthic community structure and to determine if groundwater upwelling might be a source of nutrients and chlorinated pesticides. The detection of insecticides and phthalic acid esters (PAEs) in the Black Creek area was not surprising since previous studies have confirmed their presence in the sediments. In addition, the extensive use of the drainage area of the creek for agricultural purposes would certainly provide a source. What is important to note is that these compounds were detected in the pore water indicating that they can become mobile and be introduced into the water column. The groundwater could transport contaminants from inland agricultural areas or landfill disposal sites. Although the results from this study, regarding the occurrence and magnitude of groundwater upwelling we inconclusive, the sediment pore waters did indicate contamination by insecticides and PAEs. Analysis of pore water for chlorinated pesticides, PCBs, and PAEs in the area north of Black Creek indicated that this area was degraded more than the impacted or southern comparison site. Mean sample concentrations in the northern comparison site were three times that at the impacted site and there were 0.6 more compounds/sample. This area had particularly high concentrations of DDD, DDT, dieldrin, endosulfan, and heptachlor epoxide. These compounds, although presently banned or use restricted in the U.S., are all very effective, commonly used agriculture foliar or soil insecticides. (Lantz-PTT)
W89-08532

IMPROVED PARAMETERIZATIONS FOR SURFACE RESISTANCE TO GASEOUS DRY DEPOSITION IN REGIONAL-SCALE, NUMERICAL MODELS,
Argonne National Lab., IL. Biological and Medical Research Div.
M. L. Wesely.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-225099. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/025, June 1988. 50p, 1 fig, 3 tab, 55 ref. DOE Contract DW89932394-01.

Descriptors: *Air pollution effects, *Water pollution sources, *Acid rain, *Mathematical models, *Path of pollutants, *Gases, *Model studies, *Bioaccumulation, Nitrites, Nitric acid, Peroxides, Ammonia, Peroxyacetyl nitrate, Organic acids, Sulfur dioxide, Chemical reactions, Dry deposition.

Methods for estimating the dry deposition velocities of atmospheric gases in the United States and surrounding areas have been improved. The improvements have been incorporated into a revised module of computer coding for use in numerical models of atmospheric transport and deposition of pollutants over regional scales. The dry deposition module computes deposition velocities for five seasonal categories and 11 land use types specified in a land use map. The key improvement is the computation of bulk surface resistances according to thee distinct pathways of mass transfers to the upper portions of vegetative canopies; to the lower portions of canopies or structures; and to the ground (or water surface). With the surface resistances divided explicitly into several pathways, the bulk surface resistances for a large number of gases can be computed, if estimates of the effective Henry's Law constants and appropriate measures of the chemical reactivity of the various substances are known. This has been accomplished successfully for H2O2, HCHO, acetaldehyde, methyl hydrogen peroxide, peroxyacetic acid, HCOOH, NH3, PAN, and HNO2, in addition to the original species (SO2, O3, NOx, and HNO3). Other factors considered include surface temperature, stomatal response to environmental parameters, the wetting of the surface by dew or rain, and the covering of surfaces by snow. Surface emission of gases and variations of the uptake characteristics by individual plant species are not explicitly considered. (Author's abstract)
W89-08536

SUPERFUND ENFORCEMENT DECISION DOCUMENT: LITCHFIELD AIRPORT/PHOENIX, AZ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08539

SUPERFUND RECORD OF DECISION: GOLD COAST, FL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08541

FLEXIBLE REGIONAL EMISSIONS DATA SYSTEM (FREDS) DOCUMENTATION FOR THE 1980 NAPAP EMISSIONS INVENTORY,
Alliance Technologies Corp., Bedford, MA.
L. G. Lebowitz, and A. S. Ackerman.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-129499. Price codes: A18 in paper copy, A01 in microfiche. Report No. EPA/600/7-87/025a, November 1987. 423p, 13 fig, 1 tab, 5 ref, 6 append. EPA Contract 68-02-3997.

Descriptors: *Documentation, *Acid rain, *Air pollution, *Surveys, *Data storage and retrieval, *Computer programs, *Water pollution sources, Data collections, Flexible Regional Emissions Data System, Water pollution, Data storage, Data acquisition.

The report documents the development of the Flexible Regional Emission Data System (FREDS) for the 1980 National Acid Precipitation Assessment Program Emissions Inventory. FREDS extracts emissions data, pertinent modeling parameters (e.g., stack height, exhaust gas temperature), and source identification information and applies appropriate temporal, spatial, and pollutant species allocation factors to derive a gridded, speciated and temporally resolved emissions file suitable as input to regional scale atmospheric simulation models (e.g., Regional Acid Deposition Model, Regional Oxidant Model). FREDS consists of five main modules which are used to apply allocation factors to the annual emissions data, plus peripheral software used to ensure the quality of and maintain the allocation factor files. Separate programs are used to process point and area sources. The five primary modules are the Model Data Extraction Module, the Temporal Allocation Module, the Speciation Module, the Spatial Allocation Module, and the Model Input Preprocessor. The modules can be implemented in a logical sequence or independently of the others. In addition, FREDS has been designed in a modular fashion, facilitating any future modifications to the system. FREDS and associated peripheral software are written in the language of the Statistical Analysis System (SAS) and are installed on EPA's National Computer Center's IBM 3090. (Author's abstract)
W89-08545

EFFECT OF CORRELATED INPUTS ON DO UNCERTAINTY,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
L. C. Brown, and Q. Song.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-225065. Price codes: A03 in paper copy, A01 in microfiche. 8p, 1 fig, 5 tab, 7 ref. EPA Contract 811883.

Descriptors: *Correlation analysis, *Water pollution, *Dissolved oxygen, *Mathematical analysis, *Model studies, Mathematical studies, Mathematical models, Algae, Benthic environment, Monte Carlo method, Standard deviation.

Although uncertainty analysis has been discussed in recent water quality modeling literature much of this work has assumed that all input variables and parameters are mutually independent. The objective of this paper is to evaluate the importance of correlation among the model inputs in the study of model output uncertainty. Correlation among the input variables is important in the study of output uncertainty from Streeter-Phelps type models. The standard deviation of the predicted dissolved oxygen deficit with correlated input parameters and variables can be from 20% to 40% larger than that with independent inputs. The largest effect occurs in the vicinity of the sag point. The major sinks and sources of dissolved oxygen (reaeration and bioxidation coefficients under moderate and high velocity, and oxygen production and respiration from algae and benthal oxygen demand under low velocity) are the dominant contributors to the uncertainties in the predicted dissolved oxygen deficit. The standard deviation of the Monte Carlo output was larger than that of the first order analysis for all simulated stream conditions regardless of whether independent or correlated inputs were used. The differences are attributed to model nonlinearity and are $< 10\%$ near the sag point, but may grow to 20-25% at long travel times. (Lantz-PTT)

W89-08549

INTERIM PROTOCOL FOR MEASURING HYDROLYSIS RATE CONSTANTS IN AQUEOUS SOLUTIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5G.
W89-08550

SUPERFUND RECORD OF DECISION: SAN GABRIEL, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08552

REMOTE SENSING ASSESSMENT OF ENVIRONMENTAL IMPACTS CAUSED BY PHOSPHAT INDUSTRY DESTRUCTIVE INFLUENCE,
Academy of Mining and Metallurgy, Krakow (Poland).
For primary bibliographic entry see Field 7B.
W89-08582

MARINE DINOFLAGELLATE BLOOMS: DYNAMICS AND IMPACTS,
Florida Dept. of Natural Resources, St. Petersburg, FL. Bureau of Marine Research.
For primary bibliographic entry see Field 5C.
W89-08615

GROUND-WATER FLOW AND QUALITY NEAR CANON CITY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08618

TRAVELTIME AND DISPERSION IN THE NEW RIVER, HINTON TO GAULEY BRIDGE, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
D. H. Appel, and S. B. Moles.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4012, 1987. 21p, 10 fig, 2 tab, 3 ref.

Descriptors: *Traveltime, *Dye dispersion, *Path of pollutants, *Stream discharge, *West Virginia, New River, Flow profiles, Fate of pollutants, River flow, Solute transport.

Traveltime and dispersion studies were conducted on a 65-mile-long reach of the New River between Hinton and Gauley Bridge, West Virginia. Four sets of measurements were made from August 1985 to May 1986 at river discharges of about 2,220, 3,200, 9,200, and 18,000 cu ft/sec, which correspond to flow durations of 85, 70, 26, and 9%, respectively. The four sets of data were used to develop generalized procedures for estimating traveltime and peak concentrations that result from spillage of water-soluble substances at any point within the study reach. The procedure will provide the approximate traveltimes and concentrations of soluble substances during periods of relatively steady flow from 1,500 to 30,000 cu ft/sec. A sample problem and solution are presented for hypothetical situation in which 500 lbs of soluble contaminant are spilled at a highway bridge near Sandstone. The river flow was 3,000 cu ft/sec for this example. The estimated times required for the leading edge and peak concentration of the solute cloud to reach Stone Cliff (25.9 river mi) were determined to be 23 and 28.5 hours. The cloud would take about 17 hours to pass Stone Cliff and the peak concentration would be 100 micrograms/L. (Author's abstract)
W89-08628

POTENTIAL FOR POLLUTION OF THE UPPER FLORIDAN AQUIFER FROM FIVE SINKHOLES AND AN INTERNALLY DRAINED BASIN IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. T. Trommer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4013, 1987. 103p, 45 fig, 10 tab, 39 ref.

Descriptors: *Geohydrology, *Sinks, *Groundwater pollution, *Water pollution sources, *Florida, Karst hydrology, Upper Floridan aquifer, Aquifers, Groundwater recharge, Groundwater quality.

Sinkholes are natural and common geologic features in west-central Florida, which is underlain by water soluble limestone deposits. Dissolution of these deposits is the fundamental cause of sinkhole development. Sinkholes and other karst features are more pronounced in the northern part of the study area, but sinkhole activity has occurred throughout the area. Fifty-eight sinkholes with known or suspected connection to the Upper Floridan aquifer are located in the study area. An internally drained basin near the city of Brandon and five sinkholes in Hillsborough, Pasco, and Hernando Counties were selected for detailed investigation. At all sites, chemical or biological constituents were detected that indicate pollutants had entered the aquifer. A generalized classification, based on the potential to pollute, was applied to the selected sites. Four of the sites have high potential and two have moderate potential to pollute the Upper Floridan aquifer. All of the sites investigated are capable of recharging large volumes of water to the Upper Floridan aquifer in short periods of time. Continued monitoring of the quality of water entering the sinkholes and of wells downgradient to the sinks is needed to assess the future impacts on the aquifer. (Author's abstract)
W89-08629

RECONNAISSANCE OF WATER QUALITY IN THE HIGH PLAINS AQUIFER BENEATH AGRICULTURAL LANDS, SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08631

PRELIMINARY APPRAISAL OF THE EFFECTS OF LAND USE ON WATER QUALITY IN STRATIFIED-DRIFT AQUIFERS IN CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08633

WATER QUALITY OF CALERO RESERVOIR, SANTA CLARA COUNTY, CALIFORNIA, 1981-83,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08648

EFFECTS ON GROUND-WATER QUALITY OF SEEPAGE FROM A PHOSPHATIC CLAYEY WASTE SETTLING POND, NORTH-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Hunn, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4107, 1986. 51p, 16 fig, 15 tab, 9 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Phosphates, *Waste disposal, Settling basins, Aquifers, Geohydrology, Fate of pollutants, Phosphorus, Iron, Aluminum, Barium, Zinc, Chromium, Sulfates, Dissolved oxygen, Groundwater movement.

Water samples were taken from test wells drilled near an inactive phosphatic clayey waste storage settling pond, from the settling pond and its perimeter ditch, and from an active settling pond near White Springs, Hamilton County, in north-central Florida. The purpose was to document the seepage of chemical constituents from the inactive settling pond and ditch into the adjacent surficial groundwater system, and to assess the potential for movement of these constituents into the deeper Floridan aquifer system which is the major source of public supply in the area. The study area is underlain by a 2,500-ft-thick sequence of Coastal Plain sediments of Early Cretaceous to Holocene age. The rocks of Tertiary and Quaternary age that underlie the test site area can be grouped into three major geohydrologic units. In descending order, these units are: surficial aquifer, Hawthorn confining unit, and Floridan aquifer system. Phosphate deposits occur in the upper part of the surficial aquifer. Water in the active settling pond is a calcium magnesium sulfate type with a dissolved solids concentration of 250 mg/L, containing greater amounts of phosphorus, iron, aluminum, barium, zinc, and chromium than the other surface waters. Water in the perimeter ditch is a calcium sulfate type with a dissolved solids concentration of 360 to 390 mg/L, containing greater amounts of calcium, sulfate, nitrogen, and fluoride than other surface waters. Water from the inactive settling pond is a calcium magnesium bicarbonate type with a dissolved solids concentration of 140 mg/L, containing more bicarbonate than the other surface waters. Large amounts of chemical constituents in the phosphate waste disposal slurry are apparently trapped in the sediments of the settling ponds. The quality of water in the upper part of the surficial aquifer from wells within 200 to 400 ft of the inactive settling pond shows no signs of chemical contamination from phosphate industry operations. The horizontal groundwater velocity calculated for this aquifer between the ditch surrounding the settling pond and the test wells is between 100 to 2,000 ft/year, which is enough time for water to have reached the test wells in the 6 years the pond has been operating. (Author's abstract)
W89-08649

CHANGES IN GROUND-WATER QUALITY RESULTING FROM SURFACE COAL MINING OF A SMALL WATERSHED IN JEFFERSON COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. Hren.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 86-4108, 1986. 38p, 15 fig, 7 tab, 5 ref.

Descriptors: *Environmental effects, *Groundwater pollution, *Coal mining, *Ohio, *Groundwater quality, Sulfates, Manganese, Dissolved solids.

Two samples were collected from each of six wells in a small watershed in Jefferson County, Ohio, in 1984. The watershed was mined and reclamation begun in 1980. Data collected from 1976 through 1982 indicate that groundwater quality was still changing at the time. Four years after mining, the upper saturated zone was destroyed by mining and replaced by spoils material during reclamation. A new saturated zone then formed in the spoils material. The pre-mining median concentrations of sulfate, manganese, and dissolved solids in the upper saturated zone were 84 mg/L, 30 micrograms/L, and 335 mg/L, respectively. The post-mining median concentrations of these constituents in the upper zone wells disturbed by mining were 360 mg/L, 595 microgram/L, and 814 mg/L, respectively. Concentrations of these constituents were still increasing in 1984 in the upper saturated zone. In the area not disturbed by mining, concentrations have remained nearly at pre-mining levels. The pre-mining median concentrations of sulfate, manganese, and dissolved solids in the middle saturated zone were 47 mg/L, 10 microgram/L, and 405 mg/L, respectively. The post-mining median concentrations of these constituents were 390 mg/L, 490 microgram/L, and 959 mg/L, respectively. In the middle saturated zone, concentrations of these

constituents also were still increasing in 1984, probably due to mixing with water of the upper saturated zone. (Author's abstract)
W89-08650

STREAMFLOW AND WATER-QUALITY DATA FOR LAKE AND WETLAND INFLOWS AND OUTFLOWS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1981-82,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08663

COMPILATION AND PRELIMINARY INTERPRETATION OF HYDROLOGIC DATA FOR THE WELDON SPRING RADIOACTIVE WASTE-DISPOSAL SITES, ST. CHARLES COUNTY, MISSOURI--A PROGRESS REPORT,
Geological Survey, Rolla, MO. Water Resources Div.
M. J. Kleeschulte, and L. F. Emmett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report, 85-4272, 1986. 71p, 14 fig, 14 tab, 24 ref.

Descriptors: *Groundwater quality, *Radioactive wastes, *Water pollution sources, Waste disposal, Disposal sites, Missouri, Geohydrology, Mine wastes, Sodium, Calcium, Sulfates, Nitrates, Fluoride, Uranium, Molybdenum, Lithium, Radium, Groundwater movement, Monitoring, Data interpretation.

The Weldon Spring Chemical Plant is located just north of the drainage divide separating the Mississippi River and the Missouri River in St. Charles County, Missouri. From 1957 to 1966 the plant converted uranium-ore concentrates and recycled scrap to pure uranium trioxide, uranium tetrafluoride, and uranium metal. Residues from these operations were pumped to four large pits that had been excavated near the plant. Small springs and losing streams are present in the area. Water overlying the residue in the pits has a large concentration of dissolved solids and a different chemical composition compared to the native groundwater and surface water. This difference is indicated by the concentrations of calcium, sodium, sulfate, nitrate, fluoride, uranium, radium, lithium, molybdenum, strontium, and vanadium, all of which are greater than natural or background concentrations. Water from Burgermeister Spring, located about 1.5 miles north of the chemical plant area, contains uranium and nitrate concentrations greater than background concentrations. Groundwater in the shallow bedrock aquifer moves northward from the vicinity of the chemical plant toward Dardenne Creek. An abandoned limestone quarry several miles southwest of the chemical plant also has been used for the disposal of radioactive waste and rubble. Groundwater flow from the quarry area is southward through the alluvium, away from the quarry and toward the Missouri River. The St. Charles County well field is located in the Missouri River flood plain near the quarry and the large yield wells are open to the Missouri River alluvial aquifer. Water from a well 4,000 ft southeast of the quarry was analyzed; there was no indication of contamination from the quarry. Additional water quality and water level data are needed to determine if water from the quarry moves toward the well field. Observation wells need to be installed in the area between the chemical plant, pits, and Dardenne Creek. The wells would be used to provide access for measurements of depth to ground water and for the collection of water samples from the shallow bedrock aquifer. (Lantz-PTT)
W89-08680

TWO-CONSTITUENT SOLUTE-TRANSPORT MODEL FOR GROUND WATER HAVING VARIABLE DENSITY,
Geological Survey, Reston, VA. Water Resources Div.
W. E. Sanford, and L. F. Konikow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4279, 1985. 88p, 4 fig, 16 ref, 4 append.

Descriptors: *Solute transport, *Groundwater pollution, *Mathematical models, *Path of pollutants, *Model studies, Computer models, Simulation analysis, Finite difference method, Flow profiles, Saline water intrusion.

A numerical model has been developed to simulate solute transport and dispersion of either one or two constituents in groundwater where there is two-dimensional, density-dependent flow. The model is a modified version of the one documented by Konikow and Bredehoeft (1978), which uses finite-difference methods and the method of characteristics to solve the flow and transport equations. The model was tested on an idealized seawater intrusion problem for which an analytical solution has been developed. The results were nearly identical to those of other numerical models tested on the same problem. A description of the formats for the input data, a sample of input and output for a two-constituent example problem, and a listing of the Fortran program are presented. (Author's abstract)
W89-08682

TRANSPORT AND VARIABILITY OF INDICATOR BACTERIA IN THE APALACHICOLA RIVER AND ESTUARY, FLORIDA, 1983-84,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-4285, 1986. 29p, 8 fig, 9 tab, 28 ref.

Descriptors: *Path of pollutants, *Bacteria, *Estuaries, *Apalachicola River, *Florida, Fate of pollutants, Coliforms, Apalachicola Bay, Rivers, Wastewater, Flood stages, Model studies, Regression analysis, Statistical analysis, Oysters.

Fecal coliform bacteria in the waters of Apalachicola Bay, Florida, are monitored regularly by the State to detect conditions where pathogens may contaminate oysters harvested for human consumption. Because coliform numbers tend to increase during periods when the Apalachicola River rises above flood stage, the general practice has been to close the bay to oyster harvesting at high river stages. Closure continues until monitoring shows that the coliform numbers do not exceed the maximum allowable limit of 14 colonies/100 ml. However, no direct evidence is available to show a simple relation between river stage and coliform numbers. To assess riverine bacterial transport, numbers of fecal coliform and fecal streptococci bacteria were monitored at 12 sites on the Apalachicola River during the spring of 1983 and winter of 1983-84. The data did not show evidence of cross-sectional patterns of variation or discrepancies between the two most common methods of analysis (membrane filtration and most probable number). Coliform numbers were generally lower near the river mouth than at sites farther upstream. At most sites, fecal coliform: fecal streptococcus ratios were < 2.0, suggesting nonhuman origin for much of the fecal bacteria. Higher ratios (up to 23) at some sites, in particular a site below a wastewater treatment facility, suggest human origins. With the exception of an outlet from a wastewater treatment facility near the river mouth, tributaries generally carried lower coliform or streptococcus concentrations than the main river channel. The data from this study suggested that the coliform:discharge relation was modified by other hydrologic factors, particularly the flood duration, the magnitude of the current flood peak relative to previous peaks, and whether the river was rising or falling. A multiple-regression model indicated that bacteria concentrations during the rising limb of the season's initial flood peak are likely to be up to 50% greater than concentrations during the falling limb of a later peak, given approximately equal discharge levels of the two peaks. In the estuary, coliform data collected at 28 sites during 1983-84 were analyzed for regional differences. (Lantz-PTT)
W89-08684

DETERMINATION OF REAERATION-RATE COEFFICIENTS OF THE WABASH RIVER, INDIANA, BY THE MODIFIED TRACER TECHNIQUE,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08687

SIMULATION OF GROUND-WATER FLOW NEAR THE NUCLEAR-FUEL REPROCESSING FACILITY AT THE WESTERN NEW YORK NUCLEAR SERVICE CENTER, CATTARAUGUS COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08692

SUPERFUND RECORD OF DECISION: MONTGOMERY TOWNSHIP, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08696

SYNOPSIS OF SALTWATER INTRUSION IN DADE COUNTY, FLORIDA, THROUGH 1984,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08718

GROUND-WATER MOVEMENT AND EFFECTS OF COAL STRIP MINING ON WATER QUALITY OF HIGH-WALL LAKES AND AQUIFERS IN THE MACON-HUNTSVILLE AREA, NORTH-CENTRAL MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08719

MAJOR AND TRACE-ELEMENT ANALYSES OF ACID MINE WATERS IN THE LEVIATHAN MINE DRAINAGE BASIN, CALIFORNIA/NEVADA--OCTOBER, 1981 TO OCTOBER, 1982,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. W. Ball, and D. K. Nordstrom.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4169, 1985. 46p, 17 fig, 5 tab, 16 ref.

Descriptors: *Aluminum, *Iron, *Sulfates, *Trace elements, *California, *Nevada, *Sulfur, *Acid mine drainage, *Pollutant identification, Surveys, Water analysis, Temperature, Hydrogen ion concentration, Specific conductivity, Organic compounds.

Water issuing from the inactive Leviathan open-pit sulfur mine has caused serious degradation of the water quality in the Leviathan/Bryant Creek drainage basin which drains into the East Fork of the Carson River. As part of a pollution abatement project of the California Regional Water Quality Control Board, the U.S. Geological Survey collected hydrologic and water quality data for the basin during 1981-82. During this period a comprehensive sampling survey was completed to provide information on trace metal attenuation during downstream transport and to provide data for interpreting geochemical processes. This report presents the analytical results from this sampling survey. Sixty-seven water samples were filtered and preserved on-site at 45 locations and at 3 different times. Temperature, discharge, pH, and Eh and specific conductance were measured on-site. Concentrations of 37 major and trace constituents were determined later in the laboratory on preserved samples. The quality of the analyses was checked by using two or more techniques to determine the concentrations including d.c.-argon plasma emission spectrometry (DCP), flame and

flameless atomic absorption spectrophotometry, UV-visible spectrophotometry, hydride-generation atomic absorption spectrophotometry and ion chromatography. Additional quality control was obtained by comparing measured to calculated conductance, comparing measured to calculated Eh (from Fe-2+/Fe-3+ determinations), charge balance calculations and mass balance calculations for conservative constituents at confluence points. Leviathan acid mine waters contain mg/L concentrations of As, Cr, Co, Cu, Mn, Ni, Tl, V and Zn, and hundreds to thousands of mg/L concentrations of Al, Fe, and sulfate at pH values as low as 1.8. Other elements including Ba, B, Be, Bi, Cd, Mo, Sb, Se and Te are elevated above normal background concentrations and fall in the microgram/L range. The chemical and 34 S/32 S isotopic analyses demonstrate that these acid waters are derived from pyrite oxidation and not from the oxidation of elemental sulfur. (Author's abstract)
W89-08748

SHALLOW GROUND-WATER FLOW, WATER LEVELS, AND QUALITY OF WATER, 1980-84, COWLES UNIT, INDIANA DUNES NATIONAL LAKESHORE,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08754

GROUND-WATER FLOW AND SOLUTE TRANSPORT IN THE EQUUS BEDS AREA, SOUTH-CENTRAL KANSAS, 1940-79,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08755

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-6A, H-6B, AND H-6C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08762

EFFECTS OF LAND USE ON GROUND-WATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-4093, 1983. 67p, 15 fig, 35 tab, 15 ref.

Descriptors: *Water pollution sources, *Groundwater quality, *Environmental effects, *Land use, *Everglades, *Groundwater pollution, *Florida, Biscayne aquifer, Aquifers, Agriculture, Iron, Potassium, Nitrates, Brackish water, Chromium, Copper, Manganese, Lead, Zinc, Polychlorinated biphenyls, Hydrocarbons, Insecticides.

Groundwater quality characteristics of the Biscayne aquifer from September 1978 through June 1979 were determined for seven land use areas within the East Everglades in Dade County, Florida. Four agricultural areas, two low-density residential areas, and Chekika Hammock State Park were investigated. The effects of land use on the groundwater were minimal in all areas; only iron, which occurs naturally in high concentrations in the Everglades, exceeded potable groundwater standards. Potassium and nitrate concentrations in certain samples increased over background concentrations in the agricultural areas. Groundwater at Chekika Hammock State Park and at a citrus grove is contaminated by brackish water flowing from an artesian well. The soil at the agricultural areas had higher concentrations of chromium, copper, and manganese than at the two residential areas or at Chekika Hammock State Park. One residential area (Coopertown) had the highest concentrations of lead and zinc and detectable polychlorinated biphenyls. Chlorinated-hydrocarbon insecticide residues in soil at three agricultural areas were higher than background concentrations. (Author's abstract)
W89-08766

HYDROLOGIC MONITORING OF SELECTED STREAMS IN COAL FIELDS OF CENTRAL AND SOUTHERN UTAH-SUMMARY OF DATA COLLECTED, AUGUST 1978-SEPTEMBER 1984,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price, and G. G. Plantz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4017, 1987. 102p, 32 fig, 21 tab, 1 plate, 14 ref.

Descriptors: *Coal mine effects, *Hydrologic data collections, *Environmental effects, *Coal mines, *Utah, *Data collections, Water quality control, Monitoring, Price River, San Rafael River, Dirty Devil River, Kanab Creek, Streamflow, Suspended sediment, Benthic fauna, Phytoplankton, Bottom sediments, Mine drainage.

The U.S. Geological Survey conducted a coal-hydrology monitoring program in coal-field areas of central and southern Utah during August 1978-September 1984 to determine possible hydrologic impacts of future mining and to provide a better understanding of the hydrologic systems of the coal resource areas monitored. Data were collected at 19 gaging stations--18 stations in the Price, San Rafael, and Dirty Devil River basins, and 1 in the Kanab Creek Basin. Streamflow data were collected continuously at 11 stations and seasonally at 5 stations. At the other three stations streamflow data were collected continuously during the 1979 water year and then seasonally for the rest of their periods of record. Types of data collected at each station included quantity and quality of streamflow; suspended sediment concentrations; and descriptions of stream bottom sediments, benthic invertebrate, and phytoplankton samples. Also, base flow measurements were made annually upstream from 12 of the gaging stations. Stream bottom sediment sampled at nearly all the monitoring sites contained small to moderate quantities of coal, which may be attributed chiefly to pre-monitoring mining. Streamflow sampled at several sites contained large concentrations of sulfate and dissolved solids. Also, concentrations of various trace elements at 10 stations, and phenols at 18 stations, exceeded the criteria of the EPA for drinking water. This may be attributed to contemporary (water years 1979-84) mine drainage activities. The data collected during the complete water years (1979-84) of monitoring do provide a better understanding of the hydrologic systems of the coal field areas monitored. The data also provide a definite base by which to evaluate hydrologic impacts of continued or increased coal mining in those areas. (Author's abstract)
W89-08772

POTENTIAL EFFECTS OF ANTICIPATED COAL MINING ON SALINITY OF THE PRICE, SAN RAFAEL, AND GREEN RIVERS, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08774

NUMERICAL SIMULATION OF ADVECTIVE-DISPERSIVE MULTISOLUTE TRANSPORT WITH SORPTION, ION EXCHANGE AND EQUILIBRIUM CHEMISTRY,
Geological Survey, Reston, VA. Water Resources Div.
F. M. Lewis, C. I. Voss, and J. Rubin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4022, 1986. 165p, 20 fig, 27 ref, 3 append.

Descriptors: *Mathematical models, *Simulation analysis, *Groundwater movement, *Model studies, *Solute transport, *Path of pollutants, *Chemical reactions, *Water chemistry, Advection, Dispersion, Sorption, Porous media, Mathematical equations.

A model was developed that can simulate the effect of certain chemical and sorption reactions simultaneously among solutes involved in advective-dispersive transport through porous media. The model is based on a methodology that utilizes physical-chemical relationships in the development of the basic solute mass-balance equations; however, the form of these equations allows their solution to be obtained by methods that do not depend on the chemical processes. The chemical environment is governed by the condition of local chemical equilibrium, and may be defined either by the linear sorption of a single species and two soluble complexation reactions which also involve that species, or binary ion exchange and one complexation reaction involving a common ion. Partial differential equations that describe solute mass balance entirely in the liquid phase are developed for each tenad (a chemical entity whose total mass is independent of the reaction process) in terms of their total dissolved concentration. These equations are solved numerically in two dimensions through the modification of an existing groundwater flow/transport computer code. (Author's abstract)
W89-08776

RELATION OF SEDIMENT AND NUTRIENT LOADS TO WATERSHED CHARACTERISTICS AND LAND USE IN THE OTISCO LAKE BASIN, ONONDAGA COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
J. E. Paschal, and D. A. Sherwood.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4026, 1987. 62p, 8 fig, 12 tab, 19 ref, 3 append.

Descriptors: *New York, *Otisco Lake, *Sediment load, *Nutrients, *Land use, *Environmental effects, *Water pollution sources, Phosphorus, Nitrogen, Nitrates, Nitrites, Seasonal variation, Agricultural runoff, Finger Lakes.

Otisco Lake, the smallest and easternmost of New York State's Finger Lakes, is the source of water supply for several villages in Onondaga County. In recent years, turbidity and algal blooms have periodically impaired the lake's use for both water supply and recreation. Principal land uses within the Otisco Lake basin are woodland (39%) and cropland (49%). Conservation practices such as contour farming, strip cropping, and diversion ditches are applied to about 47% of the cropland in the basin. Runoff and concentrations of sediment and nutrients in the five major tributaries, which together drain about 70% of the lake's watershed, were monitored from November 1981 through September 1983, and sediment and nutrient loads from the ungaged areas of the watershed were estimated. Otisco Lake received 10,600 tons of sediment, 20,600 lbs of phosphorus asp, 199,000 lbs of total kjeldahl nitrogen as N, and 236,000 lbs of nitrite plus nitrate as N from the five tributaries and the ungaged area during the 23-month study. Spafford Creek basin (12.0 sq mi) contributed about 72% of the annual sediment load and 46% of the annual nutrient load; the other four subbasins, which range from 2.6 to 3.7 sq mi in area, each contributed 3 to 5% of the annual sediment load and 6 to 16% of the annual nutrient load. The ungaged part of the watershed contributed 12% of the annual sediment load and 28% of the annual nutrient load. Concentrations of ammonia as N were relatively uniform through the year, although some extremely high concentrations occurred during the summer. Total Kjeldahl nitrogen concentrations were highest in the summer and lowest in the fall. Concentrations of nitrite plus nitrate were significantly lower in winter than in the rest of the year. Total phosphorus concentrations were slightly higher in the spring than at other times, and concentrations of dissolved phosphorus were slightly higher in the summer. Storms and snowmelt accounted for 70 to 90% of the runoff, 90 to 99% of the sediment load, and 70 to 98% of the

nutrient loads from the tributaries. The largest nutrient loads occurred during the spring of each year, when runoff was highest. About 70% of the sediment, 60% of total Kjeldahl nitrogen, 58% of total phosphorus, and 53% of nitrite plus nitrate were transported during spring high flows. (Lantz-PTT)
W89-08777

POTENTIAL FOR UPDIP MOVEMENT OF SALINEWATER IN THE EDWARDS AQUIFER, SAN ANTONIO, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08782

CHEMICAL QUALITY OF PRECIPITATION AT GREENVILLE, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2B.
W89-08787

THEORETICAL TECHNIQUE FOR PREDICTING THE CUMULATIVE IMPACT OF IRON AND MANGANESE OXIDATION IN STREAMS RECEIVING DISCHARGE FROM COAL MINES,
Geological Survey, Indianapolis, IN. Water Resources Div.
K. E. Bobay.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4039, 1986. 29p, 8 fig, 4 tab, 37 ref.

Descriptors: *Coal mine effects, *Stream pollution, *Mine drainage, *Water quality, *Water pollution sources, *Iron, *Manganese, *Oxidation, *Coal mines, Hydrogen ion concentration, Computer programs, Model studies, Mine wastes, Chemical analysis, Water pollution effects, Prediction, Theoretical analysis, Simulation analysis, Dissolved oxygen.

Two U.S. Geological Survey computer programs are modified and linked to predict the cumulative impact of iron and manganese oxidation in coal-mine discharge water on the dissolved chemical quality of a receiving stream. The coupled programs calculate the changes in dissolved iron, dissolved manganese, and dissolved oxygen concentrations; alkalinity; and, pH of surface water downstream from the point of discharge. First, the one-dimensional, stead-state stream, water quality program uses a dissolved oxygen model to calculate the changes in concentration of elements as a function of the chemical reaction rates and time-of-travel. Second, a program (PHREEQE) combining pH, reduction-oxidation potential, and equilibrium equations uses an aqueous-ion association model to determine the saturation indices and to calculate pH; it then mixes the discharge with a receiving stream. The kinetic processes of the first program dominate the system, whereas the equilibrium thermodynamics of the second define the limits of the reactions. A comprehensive test of the technique was not possible because a complete set of data was unavailable. However, the cumulative impact of representative discharges from several coal mines on stream quality in a small watershed in southwestern Indiana was simulated to illustrate the operation of the technique and to determine its sensitivity to changes in physical, chemical, and kinetic parameters. Mine discharges averaged 2 cu ft/sec, with a pH of 6.0, and concentrations of 7.0 mg/L dissolved iron, 4.0 mg/L dissolved manganese, and 8.08 mg/L dissolved oxygen. The receiving stream discharge was 2 cu ft/sec, with a pH of 7.0, and concentrations of 0.1 mg/L dissolved iron, 0.1 mg/L dissolved manganese, and 8.70 mg/L dissolved oxygen. Results of the simulations indicated the following cumulative impact on the receiving stream from five discharges as compared with the effect from one discharge: 0.30 unit decrease in pH, 1.82 mg/L increase in dissolved iron, 1.50 mg/L increase in dissolved manganese, and 0.24 mg/L decrease in dissolved oxygen concentration. (Author's abstract)
W89-08789

DETECTION OF CONTAMINANT PLUMES IN GROUND WATER OF LONG ISLAND, NEW YORK, BY ELECTROMAGNETIC TERRAIN-CONDUCTIVITY SURVEYS,
Geological Survey, Syosset, NY. Water Resources Div.
T. L. Mack, and P. E. Maus.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4045, 1986. 39p, 18 fig, 4 tab, 22 ref.

Descriptors: *Measuring instruments, *Plumes, *New York, *Geophysics, *Path of pollutants, *Conductivity, *Groundwater pollution, *Long Island, Electromagnetic waves, Data acquisition, Disposal sites, Artificial recharge, Surveys, Landfills.

Electromagnetic terrain conductivity surveys were conducted at four landfills in Suffolk county and at an artificial recharge site in Nassau County to assess the feasibility of this technique for detecting contaminant plumes. The technique was successful at three of the landfills; results compared closely with those indicated by specific conductance of water from observation wells on the sites. Data from the three sites for which the technique was successful--the Horseblock Road landfill, the Manorville scavenger waste disposal facility, and the Riverhead landfill--revealed pronounced terrain conductivity anomalies that reflect known contaminant plumes. Plumes at the other two sites--Blydenburgh landfill and the East Meadow artificial recharge site--could not be detected because cultural interferences were too great and, at the Blydenburgh site, depth to water was too great. The interferences included pipelines, utility cables, and traffic. Given favorable conditions, such as high plume conductivity, lack of cultural interferences, and a depth of less than 100 ft to the plume, electromagnetic surveying can provide a rapid means of locating contaminant plumes. (Author's abstract)
W89-08794

DUAL POROSITY MODEL FOR SIMULATING SOLUTE TRANSPORT IN OIL SHALE,
Geological Survey, Cheyenne, WY. Water Resources Div.
K. C. Glover.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4047, 1987. 88p, 5 fig, 5 tab, 20 ref.

Descriptors: *Computer models, *Porosity, *Solute transport, *Oil shale, *Path of pollutants, *Groundwater movement, *Model studies, Computer programs, Simulation analysis, Geologic fractures, Geohydrology.

A model is described for simulating three-dimensional groundwater flow and solute transport in oil shale and associated geohydrologic units. The model treats oil shale as a dual-porosity medium by simulating flow and transport within fractures using the finite-element method. Diffusion of solute between fractures and the essentially static water of the shale matrix is simulated by including an analytical solution that acts as a source-sink term to the differential equation of solute transport. While knowledge of fracture orientation and spacing is needed to effectively use the model, it is not necessary to map the locations of individual fractures. The computer program listed in the report incorporates many of the features of previous dual-porosity models while retaining a practical approach to solving field problems. As a result the theory of solute transport is not extended in any appreciable way. The emphasis is on bringing together various aspects of solute transport theory in a manner that is particularly suited to the unusual groundwater flow and solute transport characteristics of oil shale systems. (Author's abstract)
W89-08796

DETERMINATION OF GEOHYDROLOGIC FRAMEWORK AND EXTENT OF GROUND-WATER CONTAMINATION USING SURFACE GEOPHYSICAL TECHNIQUES AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08799

EFFECTS OF COAL STRIP MINING ON STREAM WATER QUALITY AND BIOLOGY, SOUTHWESTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08801

DIRECTION OF GROUND-WATER FLOW AND GROUND-WATER QUALITY NEAR A LANDFILL IN FALMOUTH, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
J. H. Persky.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4188, 1986. 24p, 5 fig, 4 tab, 17 ref.

Descriptors: *Groundwater quality, *Water pollution sources, *Path of pollutants, *Groundwater movement, *Landfills, *Massachusetts, Falmouth, Groundwater pollution, Ammonia, Manganese, Calcium, Potassium, Iron, Chlorides, Cadmium, Sodium, Magnesium, Arsenic, Dissolved solids, Long Pond, Leachates, Water quality.

A landfill in Falmouth, Massachusetts, is upgradient of a pond used for municipal water supply, but analysis of groundwater flow directions and groundwater quality indicates that leachate from the landfill does not threaten the municipal water supply. A network of water table observation wells was established, and water table altitudes were measured in these wells on several dates in 1981. Water quality analyses and specific conductance measurements were made on water samples from several wells in the vicinity of the landfill between October 1980 and April 1983. A water table altitude contour map of the area between the landfill and Long Pond for April 16-17, 1981, indicates that the direction of groundwater flow is primarily southwest from the landfill to Buzzards Bay. A similar map for September 2, 1981--a time at which the water table was unusually low--indicates the possibility of groundwater discharge to Long Pond from the landfill site. Groundwater quality beneath the landfill exceeded U.S. EPA water quality criteria for domestic water supply for manganese and total dissolved solids. Concentrations as high as 52 mg/L of nitrogen as ammonia and 4,500 micrograms/L (ug/L) of manganese were found. Concentrations of ammonia, manganese, calcium, potassium, and alkalinity exceeded local background levels by more than a factor of 100; specific-conductance levels and concentrations of hardness, barium, chloride, sodium, magnesium, iron, and strontium exceeded local background levels by more than a factor of 10; and cadmium concentrations exceeded local background levels by more than a factor of 5. Water quality analyses and field specific conductance measurements indicate the presence of a volume of leachate extending south-southwest from the landfill. Average chloride concentrations of landfill leachate, precipitation on the surface of Long Pond, and recharge from the remainder of the recharge area were 180, 3, and 9 mg/L, respectively. No significant degradation of the quality of water in Long Pond is expected as a result of leachate from this landfill. (Author's abstract)
W89-08810

EVALUATION OF WATER-QUALITY DATA FROM HYDROLOGIC ACCOUNTING UNIT 051100, GREEN RIVER BASIN, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08827

RELATIONSHIP OF NONPOINT-SOURCE DISCHARGES, STREAMFLOW, AND WATER QUALITY IN THE GALENA RIVER BASIN, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
S. J. Field.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4214, 1986. 48p, 17 fig, 29 tab, 34 ref.

Descriptors: *Nonpoint pollution sources, *Streamflow, *Water quality, *Galena River, *Wisconsin, Agricultural runoff, Suspended solids, Phosphorus, Ammonia, Nitrogen, Pats Creek, Dissolved oxygen.

Four small tributaries of the Galena River, Wisconsin (Madden Branch tributary, Pats Creek, Apple River, and Madden Branch) that drain nonpoint agricultural sources and receive no significant point-source discharges were monitored from October 1980 through September 1982 to determine water quality. The yields of suspended solids, volatile solids, total phosphorus, and ammonia plus organic nitrogen during the 1982 water yr were at least twice the yields of the 1981 water yr. The greatest suspended solids yield was 740 tons/sq mi from the Madden Branch tributary. The greatest yields of volatile solids (70.8 tons/sq mi), total phosphorus (2,289 lb/sq mi), and ammonia plus organic nitrogen (8,529 lb/sq mi) were from the Madden Branch. The lowest annual yields of suspended solids, volatile solids, total phosphorus, and ammonia plus organic nitrogen for both years were from the Apple River. Concentrations of many constituents were very high during runoff periods. The highest concentration of ammonia nitrogen--12 mg/L--measured during the study period was in Pats Creek during spring runoff, February 21, 1982. The highest concentration of total phosphorus, 17 mg/L, was measured in Madden Branch tributary during a storm on July 10, 1982. The storm of July 10 exceeded a 100-yr recurrence interval of a 1-hr storm intensity for the area. Dissolved oxygen concentration sags were noted at three of the monitoring stations during surface runoff. Concentrations of many constituents exceeded State and Federal water quality standards. Dissolved oxygen concentrations were lower than the minimum State standard on numerous occasions at all sites except Madden Branch tributary. Most phosphorus concentrations during periods of surface runoff at all sites exceeded EPA standards. Concentrations of ammonia nitrogen potentially exceeded the Wisconsin State standard only once at Pats Creek. (Lantz-PTT)
W89-08829

ESTIMATING THE TRANSPORT AND DEPOSITION OF MINING WASTE AT OK TEDI,
Ok Tedi Mining Ltd., Port Moresby (Papua New Guinea).
R. J. Higgins, G. Pickup, and P. S. Cloke.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 949-971, 5 tab, 4 fig, 24 ref.

Descriptors: *Deposition, *Path of pollutants, *Sediment transport, *Streamflow, *Mine wastes, *Mine drainage, *New Guinea, Model studies, Field tests, Sediment distribution, Sediment discharge, Mathematical models, Algorithms, Economic efficiency, Data processing, Ok Tedi, Estimating, Bed load, Turbulent flow, River flow, Stream profiles.

The history of sediment transport assessments at Ok Tedi illustrates the problems of addressing a real world problem with poor quality data, changing assumptions, varying perspectives and a far from perfect body of theory. Estimates of natural loads have ranged over more than an order of magnitude for the same stream, with some figures being quite inappropriate when viewed from a geomorphological rather than an engineering perspective. However, considerable significance has been attached to the natural load, since mine-induced loads have been seen as either several times less than, or several times more than, background conditions. Where a wide range of river characteristics is encountered, a high degree of flexibility must be maintained in the selection of assessment methods. Both the sediment transport equation and the computational algorithm must be carefully matched to their application. Detailed sediment routing models potentially offer the most reliable results, but can be expensive to establish and to supply with sufficient data to support their claim to accuracy. They can support the data collection effort, however, by allowing sensitivity testing of most parameters within their likely range. Data collection can then be concentrated on the more sensitive areas. A clearly identified deficiency in existing sediment transport technology is lack of widely tested procedures for bed load estimation in steep and turbulent mountain streams, which can apparently transport more material than conventional calculations show. (See also W89-08934) (White-Reimer-PTT)
W89-08965

PROCESSES AFFECTING THE DISTRIBUTION OF SELENIUM IN SHALLOW GROUND-WATER OF AGRICULTURAL AREAS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
S. J. Deverel, and R. Fujii.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File 87-220, 1987. 14p, 13 fig, 24 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Selenium, *San Joaquin Valley, *California, Agricultural runoff, Drainage systems, Evaporation, Irrigation, Chlorides, Sodium sulfate, Calcium sulfate, Calcium bicarbonate.

A study was undertaken to evaluate the processes affecting the chemistry of shallow groundwater associated with agricultural drainage systems in the western San Joaquin Valley, California. The study was prompted by a need for an understanding of selenium mobility in areas having high selenium concentrations in shallow groundwater. Groundwater samples were collected along transects in three artificially drained fields where the age of the drainage system varied (15, 6, and 1.5 years). Selenium concentrations in the drainage water also varied (430, 58, and 3700 mg/L, respectively). Isotopic enrichment and chemical composition of the groundwater samples indicate that saline- and selenium- enriched water has evolved as a result of evaporation of groundwater. This evaporated, isotopically enriched water is being displaced by more recent, less saline irrigation water percolating through the root zone. This placement seems to be a process in which sodium chloride and sodium sulfate water is being replaced by more dilute calcium sulfate and calcium bicarbonate water. (Author's abstract)
W89-08991

SURFACE WATER-QUALITY ASSESSMENT OF THE KENTUCKY RIVER BASIN, KENTUCKY: PROJECTION DESCRIPTION,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08993

SURFACE- AND GROUND-WATER QUALITY DATA AT SELECTED LANDFILL SITES IN MECKLENBURG COUNTY, NORTH CAROLINA, 1980-86,
Geological Survey, Raleigh, NC. Water Resources Div.
W. H. Eddins, and A. P. Cardinell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-564, 1987. 393p, 5 fig, 6 tab, 6 ref, 4 append.

Descriptors: *Landfills, *Garbage dumps, *Data collections, *Surface water, *Groundwater quality, *Water quality, *Monitoring, Waste disposal, North Carolina, Data acquisition, Biological studies, Physical properties, Chemical analysis, Urban areas.

The U.S. Geological Survey initiated an urban water quality study in 1979 in cooperation with the City of Charlotte and Mecklenburg County, North Carolina, to study, among other things, the effects of solid waste disposal on the water quality in Mecklenburg County. Water quality samples (747 inorganic and 168 organic) were collected at 20 surface water sites and 53 monitoring wells at four selected landfills from 1980 to 1986. Samples were analyzed for 142 selected physical and biological parameters, major ions, nutrients, trace metals, and (or) organic compounds. Results from all analyses are presented in tabular form in the appendices. Each appendix is divided into a surface water and a groundwater section. Within each water quality table the data is presented in the following order: field measurements, physical properties, biological constituents (if analyzed), major cations, major anions, dissolved and total solids, nutrients, trace inorganic constituents, and organic constituents. (Lantz-PTT)
W89-08997

DATA ON SURFACE-WATER QUALITY AND QUANTITY, LOWER EDGEWOOD CREEK BASIN, DOUGLAS COUNTY, NEVADA, 1984-85,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08998

WATER-QUALITY AND SEDIMENT-CHEMISTRY DATA OF DRAIN WATER AND EVAPORATION PONDS FROM TULARE LAKE DRAINAGE DISTRICT, KINGS COUNTY, CALIFORNIA, MARCH 1985 TO MARCH 1986,
Geological Survey, Sacramento, CA. Water Resources Div.
R. Fujii.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-700, 1988. 19p, 2 fig, 12 tab, 6 ref.

Descriptors: *Selenium, *Water pollution sources, *Pesticides, *Water quality, *California, *Sediment contamination, Drainage districts, Tulare Lake, Salinity, Specific conductivity, Boron, Molybdenum, Arsenic, Selenium, Atrazine, Prometone, Pollutant identification, Propazine, Evaporation area, DDD, DDE.

Trace element and major ion concentrations were measured in water samples collected monthly between March 1985 and March 1986 at the MD-1 pumping station at the Tulare Lake Drainage District evaporation ponds, Kings County, California. Samples were analyzed for selected pesticides several times during the year. Salinity, as measured by specific conductance, ranged from 11,500 to 37,600 microsiemens/centimeter; total recoverable boron ranged from 4,000 to 16,000 micrg/L; and total recoverable molybdenum ranged from 630 to 2,600 microg/L. Median concentrations of total arsenic and total selenium were 97 and 2 microg/L. Atrazine, prometone, propazine, and simazine were the only pesticides detected in water samples collected at the MD-1 pumping station. Major ions, trace elements, and selected pesticides also were analyzed in water and bottom-sediment samples from five of the southern evaporation ponds at Tulare Lake Drainage District. Water enters the ponds from the MD-1 pumping station at pond 1 and flows through the system terminating at pond 10. The water samples increased in specific conductance (21,700 to 90,200 microsiemens/centimeter) and concentrations of total arsenic (110 to 420 microg/L), total recoverable boron (12,000 to 80,000 microg/L) and total recoverable molybdenum (1,200 to 5,500 microg/L) going from pond 1 to pond 10, respectively. Pesticides were not detected in water from any of the ponds sampled. Median concentrations of total arsenic and total selenium in the bottom sediments were 4.0 and 0.9 microg/g, respectively. The only pesticides detected in bottom sediment samples from the evaporation ponds were DDD and DDE, with maximum concentration of 0.8 microg/kilogram. (Author's abstract)

W89-09006

HYDROLOGIC-HYDROCHEMICAL CHARACTERIZATION OF TEXAS GULF COAST SALINE FORMATIONS USED FOR DEEP-WELL INJECTION OF CHEMICAL WASTES,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W89-09012

AREAL AND TEMPORAL VARIATIONS IN THE QUALITY OF SURFACE WATER IN HYDROLOGIC ACCOUNTING UNIT 120301, UPPER TRINITY RIVER BASIN, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
F. C. Wells, J. Rawson, and W. J. Shelby.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4318, 1986. 135p, 27 fig, 20 tab, 29 ref.

Descriptors: *Hydrologic data collections, *Water quality, *Surface water, *Trinity River, *Texas, Precipitation, Dissolved solids, Stream discharge, Dissolved oxygen, Biochemical oxygen demand, Nitrogen, Phosphorus, Lead, Iron, Manganese, Specific conductivity, Temporal distribution.

Hydrologic Accounting Unit 120301 is located in north-central Texas and includes that part of the Trinity River basin upstream from the National Stream Quality Accounting Network station 08062700, Trinity River at Trinidad, Texas. Normal annual precipitation ranges from about 28 in in the western part of the basin to almost 40 inches in the eastern part. Mean discharges for most stations in the study area during the 1973-82 water years were significantly larger than mean discharges for the period of record. Mean discharges throughout most of the study area during the 1982 water year were more than 300% of the long-term mean flow. Water in the upper Trinity River basin upstream of the Dallas-Fort Worth metroplex is generally a calcium bicarbonate type water. Average dissolved solids (DS) concentrations during the study period ranged from 174 mg/L in the Elm Fork Trinity River near Lewisville to 682 mg/L in Mountain Creek near Cedar Hill. Discharge weighted average (DS) concentrations during 1973-82 water years ranged from 165 mg/L in the Elm Fork Trinity River near Lewisville to 416 mg/L at Mountain Creek near Cedar Hill. Upstream of the municipal waste effluents in the Dallas-Fort Worth metroplex, average dissolved oxygen (DO) concentrations generally exceed 7.0 mg/L, average DO percent saturation values generally exceed 70%, and average biochemical oxygen demand (BOD) concentrations generally were < 4.0 mg/L. Downstream of the municipal waste effluents, average DO concentrations generally did not exceed 5.0 mg/L, average DO percent-saturation values generally were < 50%, and average biochemical oxygen demand concentrations generally were > 12.0 mg/L. Average concentrations of total nitrogen and total phosphorus increase significantly downstream of municipal waste effluents in the Dallas-Fort Worth metroplex. Lead has been detected in excess of the 50 micrograms/L maximum contaminant level, and iron has been detected in excess of the 300 micrograms secondary maximum contaminant level at two sites on streams in the study area. (Lantz-PTT)
W89-09023

WATER QUALITY IN THE ST. CROIX NATIONAL SCENIC RIVERWAY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-09024

QUALITY OF GROUND WATER IN THE COLUMBIA BASIN, WASHINGTON, 1983,
Geological Survey, Tacoma, WA. Water Resources Div.
G. L. Turney.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4320, 1986. 172p, 2 fig, 4 tab, 5 plates, 24 ref.

Descriptors: *Hydrologic data collections, *Groundwater pollution, *Groundwater quality, *Columbia River Basin, Washington, Hydrogen ion concentration, Specific conductivity, Coliforms, Bacteria, Iron, Manganese, Nitrates, Heavy metals, Trace metals, Fluorides, Zinc, Barium, Dissolved solids.

Groundwater from 188 sites in the Columbia Basin of central Washington was sampled and analyzed in 1983 for pH, specific conductance, and concentrations of fecal coliform bacteria, major dissolved ions, and dissolved iron, manganese, and nitrate. Twenty of the samples were also analyzed for concentrations of dissolved trace metals including aluminum, arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc. The predominant water types were sodium bicarbonate and calcium bicarbonate. The sodium bicarbonate water samples had higher pH, fluoride, and sodium:adsorption ratio values than samples with other water types. Dissolved solids concentrations were generally between 250 and 500 mg/L. Iron and manganese concentrations were usually < 10 micrograms/L (ug/L). Most trace metal concentrations were also < 10 ug/L except for barium and zinc, which had maximum concentrations of 170 and 600 ug/L, respectively. Nitrate concentrations were < 1.0 mg/L in water from more than half the wells sampled. Concentrations exceeded 1.0 mg/L in large areas of Lincoln, eastern Adams, Franklin and southern Grant Counties. No fecal coliform bacteria were detected. U.S. EPA drinking water regulations were exceeded in several samples, most commonly involving pH and concentrations of fluoride, nitrate, and dissolved solids in samples from Adams and Grant Counties. Generally, the historical data lead to similar conclusions about the quality of groundwater in the Columbia Basin region. However, historical samples had higher dissolved solids concentrations in Douglas County. Historical samples also included fewer sodium bicarbonate type waters in the region as a whole than the 1983 samples. These differences may be due to inconsistencies in data collection or analytical methods. (Author's abstract)
W89-09025

EXTENT AND SOURCE OF SALTWATER INTRUSION INTO THE ALLUVIAL AQUIFER NEAR BRINKLEY, ARKANSAS, 1984,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09026

GROUND-WATER LEVELS AND DIRECTION OF GROUND-WATER FLOW IN THE CENTRAL PART OF BERNALILLO COUNTY, NEW MEXICO, SUMMER 1983,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09029

POTENTIAL IMPACTS OF DISCHARGING TERTIARY-TREATED WASTEWATER INTO PORT ROYAL SOUND, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-09030

ORGANIC COMPOUNDS IN GROUND WATER NEAR A SANITARY LANDFILL IN THE TOWN OF BROOKHAVEN, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
K. A. Pearsall, and E. J. Wexler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4218, 1986. 22p, 5 fig, 6 tab, 17 ref.

Descriptors: *Organic compounds, *Groundwater quality, *Sanitary landfills, *Pollutant identification, Brookhaven, New York, Leachates, Benzene, Chlorobenzene, Ethyl benzene, Naphthalene, Water pollution sources, Path of pollutants, Aromatic compounds.

Landfill leachate and groundwater near the Brookhaven landfill site were analyzed for volatile, acid-extractable, and base/neutral-extractable organic compounds classified by EPA as 'priority pollutants,' and for dissolved organic carbon (DOC) and inorganic constituents. Thirteen priority pollutants were detected, including benzene, chlorobenzene, ethyl benzene, and naphthalene. The most commonly detected priority pollutant, benzene, was found in the landfill leachate and in five groundwater samples. The concentration of ethyl benzene was the highest of all organic compounds detected--55 micrograms/L (ug/L) in the leachate. Three samples downgradient from the site contained detectable levels of priority pollutants; two of these from wells 2000 ft downgradient from the site, contained trace amounts of chloroform, and the other, from a well 500 ft downgradient, contained four priority pollutants in concentrations totaling less than 20 ug/L. DOC concentrations ranged from 410 mg/L in the leachate to 0.8 mg/L, which is considered background level for groundwater upgradient of the landfill site. Samples from downgradient wells contained less than 8 mg/L DOC except at two wells 500 ft from the site, which contained 21 and 16 mg/L. (Author's abstract)
W89-09038

DISSOLVED CONSTITUENTS INCLUDING SELENIUM IN WATERS IN THE VICINITY OF KESTERSON NATIONAL WILDLIFE REFUGE AND THE WEST GRASSLAND, FRESNO AND MERCED COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09040

HYDROGEOLOGY AND EFFECTS OF LANDFILLS ON GROUND-WATER QUALITY, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. T. deRoche.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4222, 1985. 58p, 13 fig, 9 tab, 24 ref.

Descriptors: *Ohio, *Water quality, *Geohydrology, *Landfills, *Groundwater quality, *Path of pollutants, *Waste disposal, *Groundwater movement, Scioto River, Wells, Fate of pollutants, Dissolved solids, Ammonia, Carbon dioxide, Aromatic compounds, Metals, Organic compounds, Leachates.

Geohydrology and water quality were evaluated near five landfills along a 5 mi segment of the Scioto River valley south of Columbus, Ohio. Heterogeneous surficial deposits of sand, gravel, and till up to 160 ft thick are hydraulically connected to the underlying Devonian limestone, the landfills, and Scioto River, which has been leveed with 12 to 35 ft of refuse. Groundwater withdrawals caused a maximum 21 ft decline in groundwater levels from 1979 to 1982. The study reach of Scioto River within the influence of groundwater pumping is a losing stream, except for a small segment adjacent to one landfill. Analysis of variance indicated significant differences in groundwater quality between wells upgradient of landfills, downgradient of landfills, and wells penetrating refuse. Elevated specific conductance and concentrations of total dissolved solids, ammonia, carbon dioxide, and dissolved organic carbon in water from wells downgradient from and penetrating landfills indicated leachate production and migration is occurring. Analysis of bed material samples

from Scioto River and Scioto Big Run revealed concentrations of polynuclear aromatic hydrocarbons ranging from 220 to 9,440 micrograms/kg (ug/kg) of sediment and concentrations of toxic metals ranging from 1 to 720 ug/kg. Samples from an upstream control station on Scioto River contained no organic compounds and lower concentrations of metals (ranging from 1 to 260 ug/kg). Because of multiple land uses within the study area, organic compounds recovered form the streambed sediments cannot be attributed to any single source. The generation of hydrogen sulfide and methane gases, presence of a zone of increased hardness, elevated concentrations of common ionic species, and dominance of ammonia over other nitrogen species indicate that leachate is being produced and is migrating from four landfills and the river levee. Based on hydraulic relationships between groundwater and surface water, it is highly probable that ground water contaminated by leachate from the levee and from one of the landfills is discharging to the Scioto River. Leachate-enriched groundwater from other landfills also may begin to discharge to the river if water withdrawal patterns in the study area change. (Author's abstract)
W89-09042

SYNTHESIS OF THE RESULTS OF THE FIELD VERIFICATION PROGRAM WETLAND DISPOSAL ALTERNATIVE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Simmers, R. G. Rhett, S. H. Kay, and B. L. Folsom.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report D-89-2, February 1989. Final Report. 48p, 13 fig, 11 tab, 38 ref, append.

Descriptors: *Path of pollutants, *Spoil banks, *Field tests, *Wetlands, Waste disposal, Heavy metals, Bioassays, Estuaries, Organic compounds, Tidal effects.

Contaminated dredged material from the Black Rock Harbor (BRH) maintenance dredging project of the U.S. Army Engineer Division, New England, was used to field verify: (a) procedures for predicting contaminant mobility into plants; and (b) procedures for predicting contaminant mobility into animals. The wetland disposal site was constructed within a protected area using conventional construction techniques and was hydraulically filled from barges. The estuarine plant bioassay procedure was used in the laboratory to evaluate heavy metal uptake by plants from composited BRH sediment. In general, the laboratory plant bioassay adequately predicted heavy metal content of field-grown Spartina alterniflora during the first 2 years following establishment of the wetland. The wetland animal bioassay was applied to composited BRH sediment in the laboratory using an adaptation of the plant bioassay apparatus. A preliminary dynamic, tidal simulation rather than static bioassay was conducted using undiluted BRH sediment. The wetland animals not only survived in the simulated tidal bioassay, but results indicated that there was a potential for accumulation of heavy metals and organic contaminants. A second series of animal bioassays using tidal simulation was used with dredged material collected from the field site. Results of this series of bioassays agreed with the first series of simulated tidal bioassays; there is a potential for wetland animals in contact with contaminated dredged material to accumulate contaminants. Comparison of field-collected animal data with the laboratory tidal bioassay data suggests that tidal simulation bioassay procedures are somewhat overpredictive of organic contaminant bioaccumulation. No clear pattern between laboratory data and either of the field experiments emerged for heavy metals. Additional testing is recommended before an appropriate wetland animal bioassay procedure can be recommended. (Lantz-PTT)
W89-09046

SUMMARY OF DATA ON MUNICIPAL SOLID WASTE LANDFILL LEACHATE CHARACTERISTICS: 'CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS', (40 CFR PART 258),
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5A.
W89-09048

MOVEMENT AND FATE OF SOLUTES IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER, CAPE COD, MASSACHUSETTS: U.S. GEOLOGICAL SURVEY TOXIC WASTE GROUND-WATER CONTAMINATION PROGRAM.
Geological Survey, Boston, MA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-475, 1984. Papers presented at the Toxic Waste Technical Meeting, Tucson, Arizona, March 20-22, 1984. 175p. Edited by Denis R. LeBlanc.

Descriptors: *Path of pollutants, *Plumes, *Fate of pollutants, *Groundwater pollution, *Wastewater, *Cape Cod, *Massachusetts, Aquifers, Conferences.

The U.S. Geological Survey (USGS) has begun a nationwide program to study the fate of toxic wastes in groundwater. Several sites where groundwater is known to be contaminated are being studied by interdisciplinary teams of geohydrologists, chemists, and microbiologists. The objective of these studies is to obtain a thorough quantitative understanding of the physical, chemical, and biological processes of contaminant generation, migration, and attenuation in aquifers. One of the sites being studied by the USGS under this program is a plume of sewage contaminated groundwater on Cape Cod, Massachusetts. The plume was formed by land disposal of treated sewage to a glacial outwash aquifer since 1936. This report summarizes results obtained during the first year of research at the Cape Cod s under the USGS Toxic-Waste Ground-Water Contamination Program. The seven papers included in this volume were presented at the Toxic Waste Technical Meeting, Tucson, Arizona, in March 1984. They provide an integrated view of the subsurface distribution of contaminants based on the first year of research and discuss hypotheses concerning the transport processes that affect the movement of contaminants in the plume. (See W89-09053 thru W89-09059) (Lantz-PTT)
W89-09052

DESCRIPTION OF THE HAZARDOUS-WASTE RESEARCH SITE,
Geological Survey, Boston, MA. Water Resources Div.
D. R. LeBlanc.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 1-9, 6 fig, 2 tab, 7 ref.

Descriptors: *Plumes, *Fate of pollutants, *Path of pollutants, *Massachusetts, *Water pollution sources, *Waste disposal, *Hazardous wastes, *Groundwater pollution, Aquifers, Infiltration, Sand aquifers, Stratigraphy, Groundwater movement.

Disposal of treated sewage since 1936 to a sand and gravel aquifer at Otis Air Base, Cape Cod, Massachusetts, has formed a plume of contaminated groundwater that is more than 11,000 ft long. The plume is being studied by the U.S. Geological Survey as part of a nationwide program to understand the fate of toxic wastes in groundwater. More than 8 billion gal of secondarily treated sewage have been discharged to the aquifer at the Otis Air Base sewage plant since 1936. Disposal is by rapid infiltration through sand beds. The aquifer that receives the treated sewage is composed of 90 ft to 140 ft of stratified sand and gravel outwash underlain by silty sand and by till. Groundwater in the outwash is unconfined and moves southward toward Nantucket Sound at a rate of about 1 ft/day. (See also W89-09052) (Author's abstract)
W89-09053

DIGITAL MODELING OF SOLUTE TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
D. R. LeBlanc.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 11-44, 16 fig, 3 tab, 27 ref.

Descriptors: *Model studies, *Groundwater movement, *Massachusetts, *Cape Cod, *Computer models, *Solute transport, *Wastewater, *Groundwater pollution, *Path of pollutants, Boron, Sand aquifers, Aquifers, Infiltration, Model studies, Geohydrology, Flow pattern, Flow velocity, Simulation analysis.

Conservative solute transport of boron in a sewage plume in a sand and gravel aquifer was simulated with a groundwater flow and solute transport model. The plume was formed by disposal of treated sewage through infiltration beds to an unconsolidated water table aquifer at Otis Air Base, Cape Cod, Massachusetts, since 1936. The two-dimensional, method-of-characteristics model was used to study the hydrologic and geologic factors that affect movement of contaminants in the aquifer. Flow was assumed to be independent of solute concentration and was simulated separately from solute transport. During calibration of the steady-state flow model, the best match between observed and computed water levels was obtained with a hydraulic conductivity of about 190 ft/day. Groundwater velocities, which averaged about 1 ft/day, were computed from the flow model results and an estimated effective porosity of 0.35. The areal location of the simulated boron plume agreed reasonably well with the location of the plume observed in 1978-79 after 40 yr of disposal. Differences between the observed and simulated locations of the plume were due, in part, to inaccurate preliminary delineation of the plume from analyses of water samples from wells. A subsequent drilling program verified the predicted location of the eastern boundary of the plume. The two-dimensional model computes average concentrations for the aquifer's entire thickness, whereas the plume occupies only part of the saturated thickness. Consequently, the model was unable to simulate the observed concentrations accurately. In these simulations, as much as 65% of the treated sewage discharges to a pond located near the infiltration beds. The beds cover an area that extends from 1,500 to 2,500 ft from the pond, and the rate of mass discharge to the pond is very sensitive to the distance between the pond and the active beds. (See also W89-09052) (Author's abstract)
W89-09054

SEWAGE CONTAMINANTS IN GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
E. M. Thurman, L. B. Barber, M. L. Ceazan, R. L. Smith, and M. G. Brooks.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 47-87, 9 fig, 4 tab, 11 ref.

Descriptors: *Massachusetts, *Cape Cod, *Plumes, *Wastewater, *Groundwater pollution, *Path of pollutants, Sand aquifers, Aquifers, Nutrients, Nitrates, Ammonia, Phosphates, Organic compounds, Volatile organic compounds, Cations, Anions.

The major cations and anions in the sewage plume at Otis Air Base, Massachusetts, are transported at the front of the plume and do not appear to be retained by the sand and gravel aquifer. Nutrients behave conservatively and nonconservatively. Nitrate moves rapidly while ammonia and phosphate are retarded. Organic constituents are present in the contaminated area of the aquifer, and detergents are a major component of the dissolved

organic carbon. Volatile organic compounds are present in the aquifer, although not as far downgradient as the detergents. Also, the volatiles make only a small contribution to the dissolved organic carbon (< 2%). (See also W89-09052) (Author's abstract)
W89-09055

CLOSED-LOOP STRIPPING, COMBINED WITH CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY ANALYSIS TO DEFINE A SEMI-VOLATILE ORGANIC CONTAMINANT PLUME,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-09056

EVIDENCE OF MICROBIAL PROCESSES IN SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
M. L. Ceazan, D. M. Updegraff, and E. M. Thurman.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 115-136, 5 fig, 2 tab, 24 ref.

Descriptors: Dentirification, *Nitrification, *Microbial degradation, *Groundwater pollution, *Plumes, *Massachusetts, *Cape Cod, *Fate of pollutants, Organic compounds, Biodegradation, Pollutant identification, Wastewater, Microbiological studies.

The importance of microbial degradation of organic compounds is investigated, as well as the transformation of inorganic compounds in the sewage plume at Otis Air Base, Massachusetts. The number of plate-count bacteria in the water was determined by plating the groundwater samples on nutrient agar and dilute soil-extract (DSEA). The number of colony-forming units (CFU) on both nutrient agar and dilute soil-extract agar showed the same spatial distributions, but dilute soil-extract agar yielded higher numbers of colony-forming units than nutrient agar. An increase in bacterial count occurred in the contaminated zone. Evidence exists that microbially mediated denitrification, dissimilatory nitrate reduction, and nitrification could be occurring in the plume. (See also W89-09052) (Author's abstract)
W89-09057

MICROBIAL DISTRIBUTION AND HETEROTROPHIC UPTAKE IN A SEWAGE PLUME,
Geological Survey, Boston, MA. Water Resources Div.
R. W. Harvey, R. L. Smith, and L. George.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 139-152, 4 fig, 2 tab, 16 ref.

Descriptors: *Microbiological studies, *Wastewater, *Plumes, *Massachusetts, *Cape Cod, *Fate of pollutants, *Groundwater pollution, Bacteria, Sediment contamination, Sand aquifers, Infiltration.

The bacterial abundance, distribution, and heterotrophic uptake in groundwater contaminated by treated sewage at Otis Air Base, Massachusetts, was determined from groundwater and sediment-core samples. Numbers of free-living bacteria in contaminated groundwater declined steadily with increasing distance from the infiltration sand beds where the treated sewage recharges the aquifer. The numbers decline from 1.94 million/ml at depth of 6 m to 1.58 million/ml at a depth of 14 m, then declined at depths of 20 m and 31 m to 1.29 million/ml and 0.96 million/ml respectively. A majority of the bacteria in contaminated and uncontaminated zones of the aquifer were bound to surfaces of particulates with diameters of < 60 micrometers. Glucose-uptake rates, assayed at in situ and 5 uM (micromolar) concentrations, declined steadily in groundwater sampled along a transect that extends from 0.64 to 1.80 km. A preparative wet-sieving technique for use in processing core samples for bacterial enumeration was fund to yield higher counts than a previously used preparative settling technique. (See also W89-09052) (Author's abstract)
W89-09058

PRELIMINARY STUDY OF DENITRIFICATION IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
R. L. Smith, and J. H. Duff.
IN: Movement and Fate of Solutes in a Plume of Sewage-Contaminated Ground Water, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Ground-Water Contamination Program. USGS Open-File Report 84-475, 1984. p 153-175, 9 fig, 1 tab, 24 ref.

Descriptors: *Plumes, *Massachusetts, *Cape Cod, *Denitrification, *Wastewater, *Groundwater pollution, *Fate of pollutants, Nitrates, Wastewater treatment, Microbiological studies.

High concentrations of nitrate (1 milliMole (mM)) were present in secondarily treated sewage entering sand infiltration beds at the Otis Air Base, Massachusetts, sewage treatment plant, as opposed to undetectable concentrations of nitrate and oxygen in the underlying groundwater. This suggested that a zone of denitrification had been established within the contaminated aquifer. Well water and core samples taken from the zone of contamination were assayed for denitrification potential using the acetylene blockage technique. Sewage effluent and slurried core material demonstrated endogenous denitrifying activity, whereas corresponding well water samples did not. Addition of nitrate (1 mM/L) had no effect upon denitrification rates but glucose + nitrate amendments (1 mM/L of each) stimulated activity in both water and core samples. In general, the highest rates of activity were evident in samples taken nearest the sand beds; samples taken from outside the contamination plume did not produce N2O under any conditions tested. These results establish that denitrification can occur in subsurface systems and thereby serve as a mechanism to remove nitrate from contaminated groundwater. (See also W89-09052) (Author's abstract)
W89-09059

WATER QUALITY DATA FOR SELECTED STREAMS TRIBUTARY TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS,
Geological Survey, Richmond, VA. Water Resources Div.
R. E. Hickman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-873, (1983). 69p, 1 fig, 1 tab, 8 ref, 5 append.

Descriptors: *Hydrologic data collections, *Water quality, *Data collections, *Potomac River, *Maryland, *Virginia, Physical properties, Estuaries, Chemical properties, Rock Creek, Anacostia River, Occoquan River, St. Clements Creek, Biochemical oxygen demand, Silica, Phosphorus, Nitrogen, Specific conductivity, Chlorophyll-a, Phytoplankton, Biomass, Turbidity.

Observations of the physical, chemical, and biological water quality of five streams draining to the tidal Potomac River and Estuary during the 1979-81 water years are tabulated. The streams sampled are Rock Creek, the Northwest and Northeast Branches of the Anacostia River, the Occoquan River, and St. Clements Creek. Samples, usually collected during storms, were routinely analyzed for sediment, biochemical oxygen demand, dissolved silica, and the total and dissolved forms of phosphorus and of nitrogen species. Additional analyses for specific conductance, chlorophyll-a, and phytoplankton abundance and generic composition were done on a few samples taken during the 1980 water year. Observations of water temperature were made during the same period. Selected measurements of the turbidity of the raw water intake for the Occoquan Water Treatment Plant also are included. (Author's abstract)
W89-09068

SELECTED HYDROLOGIC DATA, KOLOB-ALTON-KAIPAROWITS COAL-FIELDS AREA, SOUTH-CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. G. Plantz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-871, 1983. 25p, 1 fig, 8 tab, 1 plate, 5 ref.

Descriptors: *Hydrologic data collections, *Coal mining, *Environmental effects, *Water quality, *Utah, Colorado River, Virgin River, Escalante River, Paria River, Data collections, Calcium, Magnesium, Sodium, Potassium, Alkalinity, Sulfates, Chlorides, Fluorides, Silica, Nitrogen, Boron, Iron, Manganese, Wells, Springs, Streams, Water temperatures, Chemical analysis.

The Kolob-Alton-Kaiparowits coal field area includes about 4,500 sq mi in parts of the Colorado River Basin and the Great Basin. The area varies in altitude from < 4,000 to > 10,000 ft, and is comprised chiefly of plateaus, benches, and terraces that are dissected by deep, narrow canyons. Water quality was studied in principal streams draining the area, the Virgin, Sevier, Escalante, and Paria Rivers; and Coal, Kanab, and Wahweap Creeks. Most of the data included in this report were collected by the U.S. Geological Survey from October 1980 to September 1982, as part of a hydrologic study in cooperation with the U.S. Bureau of Land Management to evaluate potential impacts of coal mining on the area's water resources. Data include: discharge, water temperature, specific conductance, and pH. Data collected from selected wells and springs include: specific conductance, pH, hardness, and dissolved quantities of calcium, magnesium, potassium, sodium, sulfates, chlorides, fluorides, silica, nitrogen, boron, iron, and manganese. (Lantz-PTT)
W89-09070

HYDROLOGIC DATA FOR THE DRAINAGE BASINS OF CHATFIELD AND CHERRY CREEK LAKES, DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. W. Gibbs, L. M. Arnold, and R. L. Reed.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-857, 1983. 232p, 1 fig, 281 tab, 1 plate, 1 ref.

Descriptors: *Hydrologic data, *Chatfield Lake, *Cherry Creek Lake, *Environmental effects, *Denver, *Colorado, *Urban areas, *Eutrophication, Monitoring, Precipitation, Stream discharge, Water level, Groundwater quality, Pollution load, Water resources development, Recreation.

Chatfield and Cherry Creek Lakes are flood control lakes constructed by the U.S. Army Corps of Engineers and leased to the Colorado Division of Parks and Recreation. Both lakes are in the Denver metropolitan area and provide a variety of recreational activities, including boating, camping, fishing, picnicking, and swimming. The projected increase of urban development in the drainage basins of Chatfield and Cherry Creek lakes could increase the constituent loads delivered to the lakes. Due to the eutrophic condition of Cherry Creek Lake and the potential eutrophic condition of Chatfield Lake, increased constituent loads could affect the suitability of the lakes for recreation. A monitoring program was started to determine the constituent loads of the drainage basins to both lakes. A network of monitoring stations was established to collect ambient water quality sam-

ples, storm runoff water quality samples, precipitation, and stream discharge. In the Cherry Creek basin 12 observation wells were established in the alluvium upgradient from Cherry Creek lake. Water levels and water quality data were collected to determine the quantity and quality of groundwater entering Cherry Creek lake. Data were collected from January through December 1982. The data may be used to evaluate the present and projected impact of urbanization in the drainage basins and the effect of increased constituent loads delivered to Chatfield and Cherry Creek lakes. (Author's abstract)
W89-09077

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09079

HYDROGEOLOGY AND WATER QUALITY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS IN PARTS OF ANDROSCOGGIN, CUMBERLAND, FRANKLIN, KENNEBEC, LINCOLN, OXFORD, SAGADAHOC, AND SOMERSET COUNTIES, MAINE: SAND AND GRAVEL AQUIFER MAPS 10, 11, 16, 17 AND 32,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09085

OCCURRENCE OF URANIUM IN GROUND WATER IN THE VICINITY OF THE U.S. DEPARTMENT OF ENERGY FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
A. C. Sedam.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-099, 1985. 23p, 5 fig, 4 tab, 6 ref.

Descriptors: *Radioactive waste disposal, *Ohio, *Uranium, *Groundwater pollution, *Water pollution sources, *Waste disposal, Hazardous wastes, Fate of pollutants, Wells.

Process wastes are stored on site in rubber-lined and clay-lined pits and in large tanks at the U.S. Department of Energy Feed Materials Production Center (FMPC), where purified uranium and uranium compounds are produced. Water samples collected from off-site domestic and commercial wells in December 1981 and in August 1982, contained concentrations of dissolved uranium that ranged from < 0.4 to 430 micrograms/L (ug/L). The wells whose samples contained unusual concentrations of uranium (> 10 ug/L) lie roughly along a line extending about 2000 ft south from the southern boundary of FMPC. The offsite area affected by these concentrations is probably < 100 acres. It is not possible to determine the exact point of origination of contaminants in the groundwater on the basis of available data. (Author's abstract)
W89-09086

HYDROLOGIC AND GEOCHEMICAL DATA FOR THE BIG BROWN LIGNITE MINE AREA, FREESTONE COUNTY, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
M. E. Dorsey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-338, 1985. 17p, 3 fig, 8 tab, 10 ref.

Descriptors: *Coal mining, *Environmental effects, *Groundwater pollution, *Geochemistry, *Freestone County, *Texas, *Groundwater quality, Aquifers, Mineralogy, Hydrologic data, Sulfur, Chemical analysis, Dissolved solids.

Lignite mining in east and east-central Texas is increasing in response to increased energy needs throughout the State. Associated with the increase in mining activities is a greater need to know the effects of mining activities on the water quantity and quality of near surface aquifers. The near surface lignite beds mined at the Big Brown Lignite Mine are from the Calvert Bluff Formation of the Wilcox Group of Eocene age, which is a minor aquifer generally having water suitable for all uses, in eastern Freestone County, Texas. One of the potential hydrologic effects of surface coal mining is a change in the quality of groundwater associated with replacement of aquifer materials by mine spoils. The purpose of this report is to compile and categorize geologic, mineralogic, geochemical, and hydrologic data for the Big Brown Lignite Mine and surrounding area in east-central Texas. Included are results of paste-extract analyses, constituent concentrations in water from batch-mixing experiments, sulfur analyses, and minerals or mineral groups detected by X-ray diffraction in 12 spoil material samples collected from 3 locations at the mine site. Also, common-constituent and trace-constituent concentrations in water from eight selected wells, located updip and downdip from the mine, are presented. Dissolved solids concentrations in water from batch-mixing experiments vary from 12 to 908 mg/L. Water from selected wells contains dissolved solids concentrations ranging from 75 to 510 mg/L. (Author's abstract)
W89-09091

PRELIMINARY EVALUATION OF THE GEOHYDROLOGY AND WATER QUALITY OF THE GREENACRES LANDFILL AREA, SPOKANE COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09098

LEACHATE MIGRATION FROM AN IN SITU OIL-SHALE RETORT NEAR ROCK SPRINGS, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
K. C. Glover.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-575, 1986. 68p, 13 fig, 4 tab, 30 ref.

Descriptors: *Leachates, *Path of pollutants, *Oil shale, *Groundwater movement, *Groundwater pollution, *Wyoming, Rock Springs, Model studies, Solute transport, Aquifers, Thiocyanate, Permeability, Fate of pollutants.

Geohydrologic factors influencing leachate movement from an in situ oil shale retort near Rock Springs, Wyoming, were investigated by developing models of groundwater flow and solute transport. Leachate, indicated by the conservative ion thiocyanate, has been observed 1/2 mi downgradient from the retort. The contaminated aquifer is part of the Green River Formation and consists of thin, permeable layers of tuff and sandstone interbedded with oil shale. Most solute migration has occurred in an 8-ft sandstone at the top of the aquifer. Groundwater flow in the study area is complexly 3-D and is characterized by large vertical variations in hydraulic head. The solute transport model was used to predict the concentration of thiocyanate at a point where groundwater discharges to the land surface. Leachates with peak concentrations of thiocyanate--45 mg/L or approximately one-half the initial concentration of retort water--were estimated to reach the discharge area during January 1985. Advantages as well as the problems of site specific studies are described. Data such as the distribution of thin permeable beds or fractures may introduce an unmanageable degree of complexity to basin-wide studies but can be incorporated readily in site specific models. Solute migration in the study area primarily occurs in thin permeable beds rather than in oil shale strata. Because of this behavior, leachate traveled far greater distances than might otherwise have been expected. The detail possible in site specific models permits more accurate prediction of solute transport than is possible with basin-wide models. A major problem in site specific studies is identifying model boundaries that permit the accurate estimation of aquifer properties. If the quantity of water flowing through a study area cannot be determined prior to modeling, the hydraulic conductivity and groundwater velocity will be estimated poorly. (Author's abstract)
W89-09102

DISTRIBUTION AND MOBILITY OF SELENIUM AND OTHER TRACE ELEMENTS IN SHALLOW GROUND WATER OF THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
S. J. Deverel, and S. P. Millard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-538, 1986. 12p, 5 fig, 3 tab, 31 ref.

Descriptors: *Trace elements, *Groundwater, *Selenium, *Path of pollutants, *Groundwater pollution, *California, *San Joaquin Valley, Fate of pollutants, Salinity, Groundwater quality, Magnesium, Sodium, Chlorides, Soil types, Anions, Salinity, Boron, Molybdenum, Vanadium, Geohydrology, Alluvial fans.

Samples of shallow groundwater that underlies much of the irrigated area in the western San Joaquin Valley of California were analyzed for various major ions and trace elements, including selenium. Concentrations of the major ions generally were similar for groundwater collected in the two primary geologic zones--the alluvial fan and basin trough. Soils in the alluvial fan zone are derived from Coast Range rocks and soils in the basin-trough zone are from a mixture of Sierra Nevada and Coast Range sources. Most of the variance in concentrations of major ions, as determined by principal components analysis, was associated with groundwater salinity and the dominant ions--magnesium, sodium, sulfate, and chloride. Most of the variance in trace elements was associated with concentrations of boron, molybdenum, selenium, and vanadium, which are present as mobile oxyanions. The concentrations of oxyanions trace elements were significantly correlated ($a=0.05$) with groundwater salinity, but the correlations between selenium and salinity and molybdenum and salinity were significantly different ($a=0.05$) in the alluvial fan geologic zone compared with the basin-trough geologic zone. In addition, selenium concentrations are significantly ($a=0.05$) higher in the groundwater of the alluvial fan zone than in the basin-trough zone. The evidence suggests that the main factors influencing selenium concentrations in the shallow groundwater are the degree of groundwater salinity and geologic source of the alluvial soil material. (Author's abstract)
W89-09116

GEOHYDROLOGY OF AND POTENTIAL FOR FLUID DISPOSAL IN THE ARBUCKLE AQUIFER IN KANSAS, WITH A SECTION ON LOG ANALYSIS OF THE ARBUCKLE AQUIFER,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09122

CHEMICAL QUALITY OF GROUND WATER IN SALT LAKE VALLEY, UTAH, 1969-85,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. M. Waddell, R. L. Seiler, and D. K. Solomon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-138, 1986. 61p, 13 fig, 4 tab, 3 plates, 13 ref.

Descriptors: *Water quality, *Water pollution sources, *Groundwater quality, *Chemical analysis, *Mine wastes, *Path of pollutants, *Utah, Salt Lake, Aquifers, Wells, Water quality, Dissolved

solids, Chlorides, Sulfates, Iron, Uranium, Environmental effects.

During 1979-84, 35 wells completed in the principal aquifer in the Salt Lake Valley, Utah, that had been sampled during 1962-67 were resampled to determine if water quality changes had occurred. The dissolved solids concentration of the water from 13 of the wells has increased by more than 10% since 1962-67. Much of the ground water between the mouth of Bingham Canyon and the Jordan River about 10 mi to the east has been contaminated by seepage from reservoirs and evaporation ponds associated with mining activities. Many domestic and irrigation wells yield water with concentrations of dissolved solids that exceed 2,000 mg/L. A reservoir in the mouth of Bingham Canyon contains acidic waters with a pH of 3 to 4 and concentrations of dissolved solids ranging from 43,000 to 68,000 mg/L. Seepage from evaporation ponds, which are about 4.5 mi east of the reservoir, also is acidic and contains similar concentrations of dissolved solids. East of the reservoir, where a steep hydraulic gradient exists along the mountain front, the velocities of contaminant movement were estimated to range from about 680-1,000 ft/yr. Groundwater underlying part of the community of South Salt Lake near the Jordan River has been contaminated by leachate from uranium-mill tailings. The major effect of the leachate from the tailings of the Vitro Chemical Co. on the shallow unconfined aquifer downgradient from the tailings was the contribution of measurable quantities of dissolved solids, chloride, sulfate, iron, and uranium. The concentration of dissolved solids in uncontaminated water was 1,650 mg/L, whereas downgradient from the tailings area, the concentrations ranged from 2,320-21,000 mg/L. The maximum volume of contaminated water was estimated to be 7,800 acre-ft. The major effect of the leachate from the Vitro tailings on the confined aquifer was the contribution of measurable quantities of dissolved solids, chloride, sulfate, and iron. The concentration of dissolved solids upgradient from the tailings was 330 mg/L, and beneath and downgradient from the tailings the concentrations were 864 and 1,240 mg/L. The minimum volume of contaminated water in the confined aquifer was estimated to be about 12,000 acre-ft. (Lantz-PTT)
W89-09138

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE TULARE LAKE BED AREA, SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA, 1986-87,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-09142

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE MIDDLE GREEN RIVER BASIN, UTAH, 1986-87,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-09145

APPRAISAL OF STORM-WATER QUALITY NEAR SALEM, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09185

MOVEMENT AND FATE OF ETHYLENE DIBROMIDE (EDB) IN GROUND WATER IN SEMINOLE COUNTY, GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
J. B. McConnell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4030, 1987. 13p, 4 fig, 2 tab, 4 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Ethylene dibromide, *Fumigants, *Pesticides, *Groundwater pollution, *Georgia, Aquifers, Water pollution sources, Irrigation effects, Groundwater recharge, Wells, Geohydrology, Groundwater movement, Agricultural chemicals.

An investigation to assess the movement and fate of ethylene dibromide (EDB) in the Upper Floridan aquifer (formerly the principal artesian aquifer) was conducted, because a previous investigation conducted in August 1983, had found EDB contamination of the aquifer in about a 4 sq mi area in central Seminole County, Georgia. Analyses of water from wells resampled in June 1985 indicate that EDB was present in the groundwater 2 yr after last being applied as a soil fumigant. The investigation revealed that groundwater recharge and irrigation pumping between August 1983 and June 1985 did not substantially change the areal extent of EDB in the Upper Floridan aquifer but concentrations of EDB seem to be declining. The highest concentrations again were found in two irrigation wells near Buck Hole, a sinkhole in a swampy depression in central Seminole County. EDB concentrations in these two wells ranged from 1.5 to 13 micrograms/L. Samples from two of three wells in the residuum near Buck Hole also had detectable concentrations of EDB. The presence of EDB in water samples from wells tapping the residuum and wells tapping the Upper Floridan aquifer indicates that agriculturally applied EDB has moved downward from the surface soils through the residuum and into the aquifer. Results of aquifer tests conducted in a similar geohydrologic setting suggest that local pumping from the highly transmissive aquifer may accelerate downward movement of water and EDB. Potentiometric surface maps of the Upper Floridan aquifer indicate that east of Fishpond Drain, where the highest concentrations of EDB were detected, the direction of groundwater flow and the direction of potential EDB transport generally is south-southeasterly. However, the movement of an EDB plume from the area of relatively high concentrations near Buck Hole along inferred groundwater flow lines was not detected. (Author's abstract)
W89-09190

GEOHYDROLOGY AND SUSCEPTIBILITY OF COLDWATER SPRING AND JACKSONVILLE FAULT AREAS TO SURFACE CONTAMINATION IN CALHOUN COUNTY, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09191

CHANGES IN WATER QUALITY OF MICHIGAN STREAMS NEAR URBAN AREAS, 1973-84,
Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4035, 1987. 120p, 70 fig, 16 tab, 12 ref.

Descriptors: *Urban hydrology, *Hydrologic data collections, *Water quality, *Michigan, *Water pollution sources, Monitoring, Temporal distribution, Spatial distribution, Statistical analysis, Specific conductivity, Water pollution sources, Phosphorus, Chlorides, Sulfates, Nitrogen, Dissolved solids, Streamflow, Streams.

Monthly water quality monitoring of streams was begun by Michigan Department of Natural Resources in 1973 to: (1) determine temporal and spatial variability, (2) detect long-term trends, and (3) describe changes in water quality near urban areas. A statistical analysis and summary of data collected from 1973 through 1984 is presented. Concentrations and discharges of nine commonly measured water quality constituents and specific conductance are examined. Twenty-three sites on inland streams (streams draining basins wholly within Michigan) and 20 sites on Detroit River are discussed. The changes in water quality in 9 rivers near 12 urban areas in Michigan's southern Lower Peninsula and the relation between streamflow and selected water quality characteristics, including phosphorus, chloride, sulfate, nitrogen, specific conductance, and solid residues are described. Results show that the median dissolved solids concentration in Clinton River downstream from Pontiac exceed Michigan's 1986 stream water quality standard. Among inland streams, constituent concentrations and discharges generally were greatest in Saginaw River and least in Grand River upstream from Jackson. Greatest changes in constituent discharges occurred in the Detroit River near the Detroit area; the least occurred in the Chippewa River near Mount Pleasant. Generally, higher streamflows were associated with lower concentrations. Changes in streamflow and changes in constituent concentrations near urban areas were correlated in 57% of the 120 analyses. Generally, higher changes in streamflow were associated with lower changes in concentrations. (Lantz-PTT)
W89-09193

DATA FOR GROUND-WATER TEST HOLES IN FRESNO COUNTY, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA, JUNE TO AUGUST 1985,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09197

SUMMARY OF THE U.S. GEOLOGICAL SURVEY NATIONAL WATER-QUALITY ASSESSMENT PROGRAM,
Geological Survey, Richmond, VA. Water Resources Div.
R. M. Hirsch, W. M. Alley, and W. G. Wilber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-95, 1988. 7p.

Descriptors: *Water resources data, *Data acquisition, *US Geological Survey, *Water quality, *Project planning, Economic aspects, Planning, Eutrophication, Acidification, Salinity, Sedimentation, Long-term planning.

Beginning in 1986, the Congress has annually appropriated funds for the U.S. Geological Survey to test and refine concepts for a National Water-Quality Assessment (NAWQA) Program. The program is in a pilot phase with field studies occurring in seven areas around the Nation. The program is intended to address a wide range of national water quality issues that include chemical contamination, acidification, eutrophication, salinity, sedimentation, and sanitary quality. The goals of the program are to: (1) Provide nationally consistent descriptions of current water quality conditions for a large part of the Nation's water resources; (2) Define long-term trends (or lack of trends) in water quality; and (3) Identify and describe the relations of current conditions and trends in water quality to natural and human factors. Funding history, applications for NAWQA information, and the program design are summarized in this brief report. (Lantz-PTT)
W89-09203

FLOW IN THE UNSATURATED ZONE TUCSON, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
D. D. Graham.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-329, 1988. 2p, 2 fig, 17 ref.

Descriptors: *Aeration zone, *Groundwater pollution, *Path of pollutants, *Infiltration, Tucson, Arizona, Trichloroethylene, Pesticides, Bacteria, Organic compounds, Soil water.

Field studies in Tucson, Arizona were conducted based on the discovery of contaminants in groundwater from a substantial number of municipal and

private wells, and evidence that the presence of a thick unsaturated zone does not prevent the eventual migration of contaminants to regional groundwater systems. A pulse of water containing a tracer was monitored as it passed through the unsaturated zone by using six soil-moisture samplers (lysimeters) that were installed at depths of 11 to 45 ft, 10 ft apart, beneath a shallow, manmade, 3/4-acre recharge basin. The tracer was allowed to infiltrate into the ground for seven days, and water was collected from samplers at 12-hr intervals for about 30 days. Well defined tracer peaks, presented graphically as tracer breakthrough curves, were observed for all but one of the lysimeters installed at the site. Maximum tracer concentration showed no consistent relation with depth; tracer breakthrough sometimes occurred earlier in deep sampling locations than in shallow ones. Rather than moving straight down, water movement occurred along preferential flow paths, referred to as bypass or macropore flow, probably at low soil tension which occurs when the soil is near saturation. Under such conditions, contaminant arrival times can occur sooner than would be expected if flow was assumed to occur as a uniform wetting front that pushes ahead of it the water previously stored in the pores of the unsaturated sediments. Much of the water stored in the soil profile is not involved under conditions of bypass flow, and less interaction occurs between the recharge water and the solid matrix of the unsaturated zone. Therefore certain substances such as chlorinated hydrocarbons (trichloroethylene, pesticides), other refractory organic compounds (detergents, humic acid), and microorganisms (bacteria) could pass into the underlying groundwater. Results of this study have applicability throughout the southwestern United States as well as in other parts of the country where the practice of artificial recharge is being considered. (Lantz-PTT)
W89-09209

GEOLOGY, WATER MOVEMENT, AND SEDIMENT CHARACTERISTICS OF THE SPRING RIVER UPSTREAM FROM LA RUSSELL, SOUTHWESTERN MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
J. H. Barks, T. O. Mesko, R. A. Bohm, D. H. Meier, and J. H. Williams.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-21-WR, 1983. 33p, 7 fig, 6 tab, 8 plates, 16 ref.

Descriptors: *Geology, *Bottom sediments, *Rivers, *Karst, *Geohydrology, *Missouri, *Groundwater movement, *Path of pollutants, *Streamflow, *Suspended sediments, Spring River, Flow profiles, Groundwater pollution, Geohydrology, Aquifers, Dioxin, Fate of pollutants, Surface-groundwater relations.

The geology, water movement, and sediment characteristics in the upstream part of the Spring River basin have been appraised, to assist the U.S. EPA in their study of dioxin contamination in the area. The U.S. Environmental Protection Agency has confirmed that the dioxin compound, TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), is present in the soils, streambed sediments, and fish in the upstream part of the Spring River Basin. Although the solubility of dioxin is small, it may be moving through the hydrologic system, adsorbed on sediment particles. Water movement in the shallow aquifer generally follows the topography. In upland areas, precipitation recharges the shallow aquifer, then the shallow aquifer water discharges into larger streams. Sediment yields generally are small in the upstream part of the Spring River basin. Suspended sediment discharges for the Spring River at La Russell ranged from 3.0 tons/day at a flow of 79 cu ft/sec, 1.7 times the 7-day 2-yr low flow, to about 1240 tons/day at a flow of 1600 cu ft/sec, 6.7 times the long-term average. Suspended sediment particles in the Spring River and Honey Creek generally were silt and clay (smaller than 0.062 mm). Fine sediments with adsorbed dioxin may be transported out of the area by streamflow, or they may be deposited on flood plains or in downstream impoundments during periods of flooding. (Lantz-PTT)
W89-09226

WATER MOVEMENT IN THE UNSATURATED ZONE AT A LOW-LEVEL RADIOACTIVE-WASTE BURIAL SITE NEAR BARNWELL, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2G.
W89-09230

TEST WELLS TW1, TW2, AND TW3, WHITE SANDS MISSILE RANGE, OTERO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09231

WATEQ4F--A PERSONAL COMPUTER FORTRAN TRANSLATION OF THE GEOCHEMICAL MODEL WATEQ2 WITH REVISED DATA BASE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09232

SURFACE WATER-QUALITY ASSESSMENT OF THE LOWER KANSAS RIVER BASIN, KANSAS AND NEBRASKA: PROJECT DESCRIPTION,
Geological Survey, Lawrence, KS. Water Resources Div.
J. K. Stamer, P. R. Jordan, R. A. Engberg, and J. T. Dugan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-105, 1987. 36p, 2 fig, 2 tab, 66 ref.

Descriptors: *Water quality, *Kansas River, *Project planning, *Surface water, *Kansas, *Nebraska, *Nonpoint pollution sources, Agricultural runoff, Nutrients, Bacteria, Monitoring, Data acquisition, Land use, Sediment discharge, Reservoir silting, Pollutant identification, Wastewater, Path of pollutants, Fate of pollution, River basins.

In 1986 the U.S. Geological Survey began a National Water-Quality Assessment Program to: (1) provide nationally consistent descriptions of the current status of water quality for a large, diverse, and geographically distributed part of the Nation's surface water resources; (2) where possible, define trends in water quality; and (3) identify and describe the relation between water quality and natural and land use factors. This report describes the pilot study of the lower Kansas River basin, which is one of four surface water pilot studies that will be used to test, and modify as necessary, assessment concepts and approaches in preparation for future full implementation of the national program. Water quality issues in the lower Kansas River basin are dominated by possible nonpoint sources of contamination from agricultural land, with issues including: (1) large sediment discharge in the streams and sediment deposition in the reservoirs caused by intensive cultivation of row crops and subsequent erosion; (2) occurrence of pesticides in streams and reservoirs that could impair the suitability of water for aquatic life and has the potential for impairing the water's suitability for public supply; (3) bacterial contamination caused by runoff from pastureland and feedlot operations and municipal wastewater discharges; and (4) nutrient enrichment of reservoirs. Data from fixed stations will be used to determine frequency distributions of constituent concentrations and mass balances of constituents between stations. Subbasin or river reach studies will provide a better understanding of the origin, movement, and fate of potential contaminants. (Lantz-PTT)
W89-09235

WATER-QUALITY DATA FOR THE CLARK FORK AND SELECTED TRIBUTARIES FROM DEER LODGE TO MILLTOWN, MONTANA, MARCH 1985 THROUGH JUNE 1986,
Geological Survey, Helena, MT. Water Resources Div.
J. H. Lambing.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-110, 1987. 48p, 26 fig, 5 tab, 6 ref.

Descriptors: *Streams, *Water quality, *Data collections, *Clark Fork, *Montana, *Suspended sediments, *Trace metals, Streamflow, Sediment discharge, Hydrologic data collections, Hydrographs, Sediment concentration.

A sampling program was conducted at six stream sites. The purpose of the study was to collect baseline data on concentrations of suspended sediment and selected trace metals in streamflow. Included in this report are tables of daily data for mean streamflow, suspended sediment concentration, and suspended sediment discharge at two streamflow gaging stations on the Clark Fork; periodic data for instantaneous streamflow, onsite water quality, and trace metal and suspended sediment concentrations in the Clark Fork and tributaries; and summary statistics for all the water quality data. Also included are graphs for each site showing median concentrations of trace metals, relationship of concentrations of trace metals to suspended sediment, and median concentrations of trace metals in suspended sediments. Hydrographs for two sites on the main stem show daily mean streamflow, suspended sediment concentration, and suspended sediment discharge for the period of study. (Author's abstract)
W89-09237

GROUND-WATER-QUALITY ASSESSMENT OF THE DELMARVA PENINSULA, DELAWARE, MARYLAND, AND VIRGINIA: PROJECT DESCRIPTION,
Geological Survey, Towson, MD. Water Resources Div.
L. J. Bachman, R. J. Shedlock, and P. J. Phillips.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-112, 1987. 18p, 1 fig, 1 tab, 38 ref.

Descriptors: *Groundwater quality, *Project planning, *Delmarva Peninsula, *Delaware, *Maryland, *Virginia, Geohydrology, Land use, Agricultural runoff, Aquifers, Groundwater movement, Pesticides, Water quality, Monitoring, Trace elements, Organic compounds.

In April 1986, the U.S. Geological Survey began a pilot program to assess the quality of the Nation's surface water and groundwater resources. This National Water-Quality Assessment (NAWQA) program is designed to acquire and interpret information about a wide range of water quality issues. Three groundwater pilot projects have been started, including the project on the Delmarva Peninsula, which covers eastern Maryland and Virginia and most of Delaware. The objectives of the Delmarva project are to: (1) investigate regional groundwater quality on the Delmarva Peninsula, emphasizing a description of the occurrence of trace elements and manmade organic compounds; (2) relate groundwater quality to land use and geohydrologic conditions; and (3) provide a general description of the location, nature, and possible causes of selected water quality problems prevalent in the study area. The shallow aquifer system and the deeper aquifers used for public water supply will be addressed. The shallow aquifer system in the Delmarva Peninsula consists of permeable unconsolidated sand and gravel. Flow systems are localized and small-scale. Farming is common on the peninsula, and the migration of agricultural chemicals to the groundwater system is a local water quality concern. To assess the water quality of the groundwater resources, a regional survey for a wide range of constituents will be conducted in all of the pilot projects to provide a representative sample of groundwater analyses for a national assessment of groundwater quality. Results of this survey may be used as a baseline to monitor future water quality trends. (Lantz-PTT)
W89-09238

DISTRIBUTION OF RADIONUCLIDE AND TRACE-ELEMENTS IN GROUND WATER, GRASSES, AND SURFICIAL SEDIMENTS ASSOCIATED WITH THE ALLUVIAL AQUIFER ALONG THE PUERCO RIVER, NORTHEASTERN ARIZONA--A RECONNAISSANCE SAMPLING PROGRAM,
Geological Survey, Tucson, AZ. Water Resources Div.
R. H. Webb, G. R. Rink, and B. O. Favor.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-206, July 1987. 108p, 14 fig, 7 tab, 26 ref, 2 append.

Descriptors: *Grasses, *Sediments, *Radioisotopes, *Trace elements, *Groundwater pollution, *Puerco River, *Radioactivity, *Arizona, *Alluvial aquifers, Radium radioisotopes, Water quality, Sediment contamination, Distribution patterns, Surveys, Sampling, Radiation, Uranium.

The concentrations of gross alpha radioactivity minus uranium equaled or exceeded 15 picoCuries/L (pCi/L) in five of 14 wells sampled. The concentration of radium-226 plus radium-228 exceeded the primary water quality standard of 5 pCi/L in one well. The concentration of uranium exceeded a recommended limit of 0.035 mg/L in two wells. Perennial grass and sediment samples had low concentrations of radionuclides. The concentration of trace elements in the sediment samples was not unusual. Water quality of surface water in the Puerco River at Chambers varied as a function of the suspended sediment concentration. Concentrations of total gross alpha radiation fluctuated from 12 to 11,200 pCi/L. Concentrations of total gross beta radiation fluctuated from 45 to 4,500 pCi/L. (Author's abstract)
W89-09243

MANMADE ORGANIC COMPOUNDS IN THE SURFACE WATERS OF THE UNITED STATES; A REVIEW OF CURRENT UNDERSTANDING,
Geological Survey, Trenton, NJ. Water Resources Div.
J. A. Smith, P. J. Witkowski, and T. V. Fusillo.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-209. 182p, 26 fig, 47 tab, 699 ref.

Descriptors: *Fate of pollutants, *Literature review, *Surface water, *Organic compounds, Sediment contamination, Path of pollutants, Polychlorinated biphenyls, Herbicides, Insecticides, Phenols, Aromatic compounds, Hydrocarbons, Phthalate esters, Biodegradation, Distribution patterns, Hydrolysis, Photolysis, Solubility, Aquatic life.

On the basis of their aqueous solubilities, nonionic organic compounds partition themselves between water, dissolved organic matter, particulate organic matter, and the lipid reservoirs of aquatic organisms. Ionized organic compounds can be adsorbed to sediments, thereby reducing their aqueous concentrations. Transformation processes of photolysis, hydrolysis, biodegradation, and volatilization can attenuate organic compounds, and attenuation rates commonly follow a first-order kinetic process. Eight groups of manmade organic compounds are discussed: (1) Polychlorinated biphenyls and organochlorine insecticides; (2) Carbamate and organophosphorus insecticides; (3) herbicides; (4) phenols; (5) halogenated aliphatic and monocyclic aromatic hydrocarbons; (6) Phthalate esters; (7) polychlorinated dibenzo-p-dioxins, and (8) polycyclic aromatic hydrocarbons. For each compound group, data pertaining to use, production, and properties are presented and discussed. Processes that influence the environmental fate of each group, as determined primarily through laboratory studies, are reviewed, and important fate processes are identified. Environmental concentrations of compounds from each group in water, biota, and sediment are given to demonstrate representative values for comparison to concentrations determined during ongoing research. Finally, where sufficient data exist, regional and temporal contamination trends in the United States are discussed. (Author's abstract)
W89-09245

SURFACE-WATER-QUALITY ASSESSMENT OF THE YAKIMA RIVER BASIN, WASHINGTON: PROJECT DESCRIPTION,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-09248

DEVELOPMENT OF A DATA BASE FOR WATER-QUALITY MODELING OF THE PATUXENT RIVER BASIN, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 10A.
W89-09251

HYDROLOGIC DATA FOR THE SAN JUAN AND ANIMAS RIVER VALLEYS IN THE FARMINGTON, AZTEC, BLOOMFIELD, AND CEDAR HILL AREAS, SAN JUAN COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09254

MOVEMENT AND FATE OF CHLORINATED SOLVENTS IN GROUND WATER: RESEARCH ACTIVITIES AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo, T. A. Ehlke, and M. Martin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-395, 1987. 16p, 5 fig, 7 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chlorinated hydrocarbons, *Picatinny Arsenal, *Groundwater pollution, *New Jersey, Research priorities, Chemical properties, Physical properties, Groundwater movement, Solute transport, Metal-finishing wastes, Aquifers, Aeration zone, Geochemistry, Biodegradation.

The USGS, through its Toxic Waste--Ground-Water Contamination Program, is undertaking an interdisciplinary research study of contaminants. The purpose of the study is to gain a better understanding of the chemical, physical, and biological processes that affect the movement and fate of these contaminants in groundwater. The study is being conducted at Picatinny Arsenal, New Jersey, where metal plating and metal etching wastes have contaminated part of the glacial stratified drift aquifers. Major areas of research at the site are described, including: (1) distribution and movement of chlorinated solvents in groundwater, (2) behavior of chlorinated solvents in the unsaturated zone, (3) geochemistry of the contaminated groundwater, and (4) microbial transformations of chlorinated solvents. (Author's abstract)
W89-09258

PATTERNS OF ACID DEPOSITION VARIABILITY IN THE EASTERN UNITED STATES, 1981-84,
Geological Survey, Reston, VA. Water Resources Div.
H. F. Lins, K. J. Lanfear, and T. L. Schertz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-454, 1987. 16p, 4 fig, 2 tab, 6 ref.

Descriptors: *Water pollution sources, *Acid rain, Hydrogen ion concentration, Sulfates, Monitoring, Acidity, Distribution patterns.

An increase in pH and a decrease in sulfate concentration of precipitation were recorded at National Atmospheric Deposition Program and National Trends Network (NADP/NTN) monitoring sites in the Eastern United States between 1981 and 1984. The decline in acidity, however, was not spatially or temporally uniform. The range in acidity and sulfate concentrations decreased during the four-yr period. Variations in the area of constant pH surfaces take the general form of area reductions in both the lower (pH 4.01-4.40) and upper (pH 4.91-5.40) range of values with concomitant area increases in the middle (pH 4.41-4.90) range. The pattern for sulfate is simpler, with area increases occurring in the lower (1.0-1.9 mg/L) range, decreases in the upper (2.5-4.4 mg/L) range, with approximate stability in the middle (2.0-2.4 mg/L) range of values. (Author's abstract)
W89-09262

DISTRIBUTION OF SELENIUM IN SOILS OF AGRICULTURAL FIELDS, WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. Fujii, S. J. Deverel, and D. B. Hatfield.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-467, 1987. 16p, 6 fig, 6 tab, 26 ref.

Descriptors: *Selenium, *Soil contamination, *Agriculture, *San Joaquin Valley, *California, *Water pollution sources, Leaching, Drainage, Salinity, Solubility.

Soils from three agricultural fields in the western San Joaquin Valley were analyzed for soluble, adsorbed, and total concentrations of selenium (Se) to assess the distribution and forms of Se, and the relation of the distribution and forms of Se to the leaching of Se from soils. Soil samples were collected in three fields with drainage systems of different ages (6, 15, 1.5 yr) and different Se concentrations in drain water (58, 430, 3700 micrograms/L respectively). Preliminary methods to determine total Se and estimate adsorbed Se were developed. Of the three fields, concentrations of soluble Se and salinity were highest in soils from the field drained for 1.5 yr and lowest in the field drained for 6 yr. The field drained for 1.5 yr also had the highest concentration of total Se in soil; a median of 1.2 microgram/gm. Of the total concentration of Se in soil from all three fields, the proportion of adsorbed Se and soluble Se ranged from 1 to 11% and < 1 to 63%, respectively. Most of the variance in soluble Se is explained by salinity (r sq > 0.68) in saturation extracts of soils sampled from below the water table, reflecting evaporative concentration of Se and salinity. In contrast, most soluble salts and Se apparently have been leached from the unsaturated soils in the fields drained for 6 and 15 yr; therefore, the correlation was lower between Se and salinity in saturation extracts of those soils (r sq < 0.33). Among soils from all three fields, the ratio of Se to salinity in saturation extracts increased with increasing salinity. (Author's abstract)
W89-09264

ORGANOCHLORINE PESTICIDE RESIDUES IN BED SEDIMENTS OF THE SAN JOAQUIN RIVER AND ITS TRIBUTARY STREAMS, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. J. Gilliom, and D. G. Clifton.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-531, 1987. 15p, 4 fig, 7 tab, 19 ref.

Descriptors: *Water pollution sources, *Agricultural chemicals, *Path of pollutants, *Pesticides, *San Joaquin River, *Sediment contamination, *Pollutant identification, *California, Organochlorine, Organic compounds, DDD, DDE, DDT, Dieldrin, Endosulfan, Mirex, Toxaphene, Pesticides, Agricultural runoff.

The distribution and concentrations of organochlorine pesticide residues in bed sediments were assessed from samples collected at 24 sites in the San Joaquin River and its tributaries in the San Joaquin Valley, California. Sampling was designed to collect the finest grained bed sediments present in the vicinity of each site. One or more of the 14

pesticides analyzed were detected at every site. Pesticides detected at one or more sites were chlordane, DDD, DDE, DDT, dieldrin, endosulfan, mirex, and toxaphene. Pesticides not detected were endrin, heptachlor, heptachlor epoxide, lindane, methoxychlor, and perthane. The most frequently detected pesticides were DDD (83% of sites), DDE (all sites), DDT (33% of sites), and dieldrin (58% of sites). Maximum concentrations of these pesticides, which were correlated with each other and with the amount of organic carbon in the sample, were DDD, 260 micrograms/kg; DDE, 430 micrograms/kg; DDT, 420 micrograms/kg; and dieldrin, 8.9 micrograms/kg. Six small tributary streams that drain agricultural areas west of the San Joaquin River had the highest concentrations. Water concentrations and loads were estimated for each pesticide from its concentration in bed sediments, the concentration of suspended sediment, and streamflow. Estimated loadings of DDD, DDE, DDT, and dieldrin from tributaries to the San Joaquin River indicate that most of the loading to the river at the time of the study was probably from the westside tributaries. Estimated water concentrations exceeded the aquatic life criterion for the sum of DDD, DDE, and DDt of 0.001 microgram/L at nine of the 24 sites sampled. Five of the nine sites are westside tributaries and one is the San Joaquin River near Vernalis. (Author's abstract)
W89-09270

5C. Effects Of Pollution

GROUNDWATER FLOW AND SOLUTE TRANSPORT AT A MUNICIPAL LANDFILL SITE ON LONG ISLAND, NEW YORK. PART 2. SIMULATION OF GROUNDWATER FLOW,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08320

EFFECT OF HERBICIDE RESIDUES ON MICROBIAL PROCESSES IN CROPLAND POND OR IMPOUNDMENT SEDIMENT,
Clemson Univ., SC. Dept. of Microbiology.
S. S. Hayasaka.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-110696/AS, price codes: A03 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson, Publication No. 128, June 1988. 37p, 1 fig, 14 tab, 34 ref. USGS contract 14-08-0001-G1448. USGS project G1448-03.

Descriptors: *Microbiological studies, *Herbicides, *Aquaculture, *Catfish ponds, *Bioassay, *Agricultural runoff, Sediments, Methanogenesis, Dehydrogenase activity, Phosphatase activity, Ecology, Environmental impact statement, Water pollution effects, Water quality management, Benthic flora, Fish management, Pesticides, Mineralization, Nitrogen-fixation, Aquatic bacteria, Inorganic pesticides, Organic pesticides, Lake beds, Pollutants.

An assay system is described for examination of potential effects of herbicides on non-target sediment microorganisms. The tests are designed to be carried out in two parts; a laboratory portion to initially screen for potential effects of a herbicide (1000 ppm), then a field trial for examining herbicides applied at recommended and/or tenfold field application levels (FAL). A key feature of the procedure is that the assays are miniaturized, thereby allowing sufficient replication to establish the statistical validity of the results while minimizing the size of the soil sample which must be collected. Sediments were obtained from a catfish aquaculture pond and an adjoining lake that are adjacent to croplands. Potted sediment and undisturbed sediment cores showed no corresponding difference in glucose mineralization, acetylene reduction, phosphatase and dehydrogenase activities, but did show a significant difference in methanogenesis. Diuron, paraquat, CuSO4 and simazine could be characterized by their differential effect on the above activities after 1-wk in two different aquatic sediments. Chronic effects (4-8 wk) by these four herbicides, for the most part, were not observed. Our results support the concept that a battery of tests are required to profile and evaluate the effect of herbicides on sediment microbial communities. (Hayasake-SC WRRI)
W89-08328

EFFECT OF PREOZONATION ON THE ANAEROBIC BIODEGRADATION OF RESISTANT PHENOLIC COMPOUNDS,
Kentucky Water Resources Research Inst., Lexington.
Y. T. Wang, P. C. Pai, and J. L. Latchew.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115505/AS, price codes: A07 in paper copy, A01 in microfiche. Research Report No. 169, August 1988. 124p, 58 fig, 28 tab, 47 ref, 4 append. USGS contract 14-08-0001-G1227 (FY 86) and 14-08-0001-G1424 (FY 87). USGS projects A-108-KY G1227-03 and G1424-03.

Descriptors: *Biodegradation, *Anaerobic digestion, *Phenols, *Ozonation, *Methane, Toxicity, Water pollution effects, Organic compounds, Analytical techniques, Pollutant identification, Bioassays.

Ozone pretreatment studies of four model phenolic compounds were conducted to evaluate the effects of ozonation on the anaerobic biodegradability and toxicity of these compounds. Two types of batch studies, the Biochemical Methane Potential (BMP) and the Anaerobic Toxicity Assay (ATA), were performed on samples ozonated upon phenol, o-cresol, 2,5-dichlorophenol and 2,4-dinitrophenol. Experimental results showed that toxic and refractory phenolic compounds were converted to methane gas by means of preozonation. In general, the biodegradable fraction of the oxidation products increased as the ozone dose was increased. However, ozonation to achieve at least 60% Chemical Oxygen Demand (COD) reduction was necessary to faciliate methane production. Ozonation reduced the toxicity of 2,5-DCP and 2,4-DNP on both acetate utilization and phenol degradation. The early ozonation products of o-cresol and phenol, however, were more toxic than the initial compounds. The rates of COD and Dissolved Organic Carbon (DOC) reduction through ozonation were faster and products formed were less inhibitory in the basic pH range than in the acid pH range. (Huffsey-WRRI, U. KY)
W89-08338

WATER QUALITY DATA FOR THE BOISE RIVER, BOISE TO STAR, IDAHO, JANUARY TO MARCH 1988,
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel, and T. F. Hansen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-474, 1988. 18p, 1 fig, 5 tab, 13 ref.

Descriptors: *Water quality, *Wastewater treatment, *Benthic fauna, Trace elements, Low flow, Artificial substrates, Fish, Boise River, Idaho.

Physical and chemical data were collected at six sites and biological data were collected at five sites on the Boise River between Veterans Memorial Parkway in Boise and Star, Idaho, from January to March 1988. Data were collected to determine the effect of sewage effluent from two Boise wastewater treatment facilities on the water and biological quality of the Boise River. Similar data were collected from October to December 1987. Results of all data analyses will be discussed in an interpretive report. (USGS)
W89-08382

PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS OF THE BOISE RIVER FROM VETERANS MEMORIAL PARKWAY, BOISE TO STAR, IDAHO, OCTOBER 1987 TO MARCH 1988,
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4206, 1988. 48p, 6 fig, 13 tab, 59 ref.

Descriptors: *Water quality, *Wastewater pollution, *Water pollution effects, *Trace elements, *Benthic fauna, *Boise River, *Idaho, Artificial substrates, Fish condition factors, Water analysis.

Physical, chemical, and biological characteristics of the Boise River were examined from October 1987 to March 1988 to determine whether trace elements in effluents from two Boise wastewater treatment facilities were detrimental to aquatic communities. Cadmium, chromium, hexavalent chromium, cyanide, lead, nickel, and silver concentrations in the Boise River were less than or near analytical detection levels and were less than chronic toxicity criteria when detectable. Arsenic, copper, and zinc were detected in concentrations less than chronic toxicity criteria. Concentrations of trace elements in bottom material generally were small and could not be attributed to effluents from wastewater treatment facilities. From October to December 1987, mean density of benthic invertebrates colonizing artificial substrates was from 6,100 individuals/substrate downstream from the West Boise wastewater treatment facility to 14,000 individuals per substrate downstream from the Lander Street wastewater treatment facility. From January to March 1988, mean density of benthic invertebrates colonizing artificial substrates was from 7,100 individuals per substrate downstream from the West Boise facility to 10,000 individuals per substrate near Star. Insect communities upstream and downstream from the wastewater treatment facilities were strongly associated, and coeffients of community loss indicated that effluents had benign enriching effects. Distribution of mayflies indicates that trace-element concentrations in effluents did not adversely affect intolerant organisms in the Boise River. Condition factor of whitefish was significantly increased downstream from the Lander Street wastewater treatment facility and was significantly decreased downstream from the West Boise wastewater treatment facility. (USGS)
W89-08417

ASSESSING THE SENSITIVITY OF HIGH ALTITUDE NEW MEXICAN WILDERNESS LAKES TO ACIDIC PRECIPITATION AND TRACE METAL CONTAMINATION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-08433

AMMONIA AND PH TOXICITY AND WATER QUALITY MANAGEMENT FOR FRESHWATER SHRIMP,
Mississippi State Univ., Mississippi State. Dept. of Wildlife and Fisheries.
H. Robinette, J. M. Heinen, J. W. Pote, P. L. Strauss, and P. N. Deliman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136840/AS, price codes: A03 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1431-04, July 1988. 19p, 2 fig, 16 tab, 16 ref. USGS contract 14-34-0001-G1431. USGS project G1431-04.

Descriptors: *Shrimp, *Hydrogen ion concentration, *Ammonia, *Toxicity, *Water pollution effects, Shellfish farming, Fish farming, Aquaculture, Ponds, Alkalinity, Hardness, Buffering.

Post-larval and juvenile freshwater shrimp were exposed to pH of 8.5, 9.0, 9.5, and 10.0 +/- 0.1, and sub-adults were exposed to pH of 9.0, 9.5, 10.0, and 10.5 +/- 0.1. 0, 1,2, and 3 +/- 0.25 mg/L NH3-N were tested at each pH level. There was a synergistic toxic effect between NH3-N and high pH with juveniles more tolerant than post larvae. In general, LC50 and LC10 estimates decreased approximately 0.5 pH units from 6 h to 72 h exposures. Based upon trimmed Spearman-Karber

72 h LC10 estimates, pH and NH3-N level should not exceed 9.0 and 1 mg/L, respectively, for juveniles. Calcium chloride, calcium sulfate, and calcium carbonate were tested for effectiveness in controlling high pH in poorly buffered waters at rates ranging from 50% to 2000% of the amount of calcium required to equalize total hardness and total alkalinity. Ground corn was tested at rates from 425 to 1700 grams of carbon/pool (8800 l). Glacial acetic acid was tested at a rate of 209 grams of carbon/pool. Of all treatments, only ground corn was significant in reducing pH, but was significant at all levels for the entire four week period. (USGS)
W89-08443

TERATOGENIC EFFECTS OF ZINC ON EMBRYO-LARVAL STAGES OF THE FATHEAD MINNOW,
Eastern Kentucky Univ., Richmond. Dept. of Biological Sciences.
B. A. Ramey.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136907/AS, price codes: A03 in paper copy, A01 in microfiche. Kentucky Water Resources Research Institute, Lexington, Research Report No. 172, October 1988. 30p, 4 fig, 11 tab, 23 ref. USGS contract 14-08-0001-G1227 (FY 86) and 14-08-0001-G1424 (FY 87). USGS project G1227-06 (FY 86) and G1424-06 (FY 87).

Descriptors: *Water pollution effects, *Fathead minnows, *Bioassay, Embryonic growth stage, Larval growth stage, Teratogenic effects.

The effects of zinc on embryos and larvae of the fathead minnow (Pimephales promelas) were studied using standard 8-day embryo-larval bioassay techniques. The objective was to determine if there was a period in embryonic development which would be the most sensitive to the toxic and teratogenic effects of zinc. Five developmental stages were exposed to 0.5, 1.0 and 3.0 mg/L. After 96 hours all animals exposed to 3.0 mg Zn/L were dead. The hatching stage was the most affected by 1.0 mg/L, with only 59% surviving after 96 hours, while the tailbud stage showed essentially control-level survival. However, virtually all larvae at all stages were abnormal at 1.0 mg Zn/L, displaying edema and curvature of the vertebral axis. Although LC 50 values for the five development stages ranged from 0.13 to 0.62 mg/L, there was not a significant most sensitive stage based upon this criterion. Findings during the posthatch stage proved interesting. When larvae were exposed to 1.0 mg Zn/L only during the 96 hour after hatching, all animals were anomalous. However, if zinc exposure occurred only during the prehatch period and larvae were placed in control water posthatch, only 5% of the larvae were abnormal. These results indicate that at sublethal concentrations perhaps the chorion imparts a protective mechanism to the teratogenic effects of zinc, but that this protection is lost after hatching. (USGS)
W89-08447

ACID SOIL AND ACID RAIN: THE IMPACT ON THE ENVIRONMENT OF NITROGEN AND SULPHUR CYCLING,
Sydney Univ. (Australia).
I. R. Kennedy.
Research Studies Press Ltd., Letchworth, Hertfordshire, England. 1986. 234p.

Descriptors: *Acidic soils, *Air pollution effects, *Environmental effects, *Acid rain, *Cycling nutrients, *Path of pollutants, *Sulfur, *Nitrogen, Fate of pollutants, Acidification, Biochemistry, Chemical analysis, Ecological effects, Air pollution, Oxidation, Soil contamination.

The problems of acid soil and acid rain have much in common. Similar chemistry is involved in each and similar remedies can be prescribed for each. This book provides detailed explanations and mechanisms for acidification, both in soil and in the atmosphere. It describes the effects of acidity and how these can be prevented. Essentially a problem of the chemistry and biochemistry of various forms of nitrogen and sulfur, acidification is shown to be particularly associated with oxidative processes involving atmospheric oxygen. (Lantz-PTT)
W89-08467

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 2: EFFECTS OF ACID-FORMING EMISSIONS ON SOIL MICROORGANISMS AND MICROBIALLY-MEDIATED PROCESSES,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
S. Visser, R. M. Danielson, and J. F. Parr.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-1443441. Price codes: E04 in paper copy, A01 in microfiche. February 1987. 86p, 12 tab, 141 ref.

Descriptors: *Air pollution effects, *Literature review, *Acid rain, *Water pollution effects, *Soil contamination, *Microbiological studies, Plant populations, Plant physiology, Hydrogen ion concentration, Sulfates, Nitrogen.

Based on a review of close to 100 studies, the following general conclusions regarding the impact of acid forming emissions (mainly SO2) on soil microflora and microbially mediated processes can be made: (1) It appears that glucose mineralization patterns may be the best approach to identifying the effects of acid forming pollutants on the metabolic potential of the decomposer microflora; (2) Based on the results from both laboratory and field investigations, it appears that a reduction of naturally acidic forest soils to pH 3.0 or less will have an inhibitory effect on soil respiration; (3) Controlled laboratory and field studies have demonstrated that litter decomposition is retarded only if the plant residues are treated with extremely acidic (pH 2.0) rain or fumigated with high concentrations (530 parts per billion (ppb)) of SO2; (4) The studies performed to date suggest that the activity of most soil enzymes is adversely affected by acidic deposition only if high dosages of extremely acid (pH 2.0) rain are applied to the soil; (5) Certain factors in the nitrogen cycle are especially sensitive to acidity and thus could be adversely affected by acid emissions. There is little reduction in rates of ammonification until the pH reaches 3 or less but nitrification and N2-fixation are inhibited in soils below pH 6. It is clear that the legume-Rhizobium symbiosis in Alberta is acid sensitive; and (6) Although studies in acid emissions and mycorrhizae are few in number, they indicate that these symbiotic relationships are largely resistant to chronic emissions. (See W89-08488 thru W89-08492) (Lantz-PTT)
W89-08487

ACID DEPOSITION PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 8: THE EFFECTS OF ACIDIC DEPOSITION ON ALBERTA AGRICULTURE, A REVIEW,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
M. S. Torn, J. E. Degrange, and J. H. Shinn.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-143508. Price codes: E07 in paper copy, A01 in microfiche. February 1987. 160p, 1 fig, 39 tab, 225 ref.

Descriptors: *Air pollution effects, *Acid rain, *Water pollution effects, *Crop production, *Regulations, *Alberta, *Literature review, Agriculture, Nitrogen compounds, Sulfur dioxide, Hydrogen sulfide, Sulfur compounds, Ozone.

This review outlines the current knowledge of the effects of acidic deposition on agriculture, including plant response to pollutants, plant response to soil changes due to pollutants, and effects on interactions between plants and symbionts. Acidic deposition may trigger changes in crops, soils, and crop-symbiont interactions. The effects of wet and dry deposition on agricultural plants are discussed. In the discussions of dry deposition, the gaseous air pollutants considered are: the acid gases SO2 (sulfur dioxide), NOx (oxides of nitrogen), the oxidant O3 (ozone), and H2S (hydrogen sulfide). In the discussion of the effects on agricultural plants attention is paid to: direct effects on plant physiology; foliar responses such as visible injury, fertilization, buffering, and leaching; crop growth; and, reproduction. Relative species sensitivity to foliar injury and changes in growth and yield have been analyzed from available dose-response data. Nitrogen dioxide concentrations of 0.25 to 0.50 parts per million (ppm) for long periods of time are generally required to induce injury in sensitive agricultural plants. Ozone concentrations of 0.01 ppm and 0.10 ppm are required to induce injury in agricultural plants when exposed to O3 for several hours. Research indicates that the maximum permissible concentrations of O3 specified for acute injury are sufficient to protect agricultural plants. Because injury to sensitive agricultural species has been observed during chronic exposures at or near maximum permissible levels of gaseous pollutants when present singly, there is concern over the possible synergistic effects of these pollutants at the same concentrations when present together. The annual mean values of SO2, NOx, and O3 concentrations in Edmonton and Calgary for downtown, industrial, and residential areas for the year 1977 to 1984 are well below the maximum permissible concentrations and are apparently at safe levels. (See W89-08487 thru W89-08489 and W89-08491 thru W89-08492) (Lantz-PTT)
W89-08490

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 9: THE EFFECTS OF ACID DEPOSITION ON FORESTS,
Emporia State Univ., KS. Dept. of Biology.
J. M. Mayo.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-143516. Price codes: E04 in paper copy, A01 in microfiche. February 1987. 74p, 4 fig, 13 tab, 242 ref.

Descriptors: *Air pollution effects, *Acid rain, *Forests, *Water pollution effects, Alberta, Literature review, Ozone, Sulfur dioxide, Acidification, Soil contamination, Nitrogen fixation, Trees, Land use, Fertilization, Forestry, Cations.

Recent literature concerned with acid deposition effects upon forests is reviewed. The world-wide literature is reviewed and its relevance to the Alberta situation discussed. The discussion is confined to current material (late 1970's to present), using the older literature as necessary to complete the information in selected subject areas. The following hypotheses concerning forest decline have been proposed with considerable support data: (1) It is well established that ozone damages membranes, and inhibits photosynthesis. This has been shown for pine in California, and ozone levels in parts of Germany can reach quite high levels (e.g., levels as high as 788 micrograms/cu m/hr). It has also been clearly shown that SO2 can cause partial stomatal closure and reduce photosynthesis, and chlorophyll reduction has been proven; (2) Soil acidification can result in base cation leaching and increased availability of potentially toxic aluminum and manganese, may reduce nitrogen fixation because the infection process that produces the symbiosis between plant and bacterium is inhibited by low pH, and may decrease decomposition and reduce nitrification; (3) Land use change and secondary succession have been proposed as major causes of soil acidification; and (4) Fertilization, particularly nitrogen fertilization by NOx and NH3, may have stimulated forest growth leading to imbalances in other nutrients. The combined effects of acid deposition and forest harvest have been studied and it appears that the recent forestry practice of whole tree harvest on a shortened rotation, plus the potential for acid leaching of base cations, may prove very damaging to the survival of forests. If cations (Ca, Mg, K) are removed rapidly, then the soil will acidify. This, coupled with erosion losses, may result in forest decline. It seems likely that forests will not be able to sustain some of the proposed biomass-for-energy management much discussed during the oil shortages of the 1970's. Forest soils simply do not generate cations rapidly enough through weathering. (See W89-08487 thru W89-08490 and W89-08492) (Lantz-PTT)
W89-08491

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 10: AN ANALYSIS OF NUMERICAL MODELS OF AIR POLLUTANT EXPOSURE AND VEGETATION RESPONSE,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
S. V. Krupa, and R. N. Kickert.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-143524. Price codes: E05 in paper copy, A01 in microfiche. February 1987. 113p, 3 fig, 8 tab, 92 ref, 2 append.

Descriptors: *Air pollution effects, *Acid rain, *Mathematical models, *Vegetation, *Water pollution effects, *Model studies, Air pollution, Ecological effects, Computer programs, Fate of pollutants, Comparison studies, Performance evaluation.

A number of empirical (statistical, regression-oriented) and mechanistic (process-oriented) models are presently available to examine the relationship between air pollution stress and plant response. However, both types of models have their strengths and weaknesses. Ecological effects assessed using either of the two groups of models defined in this report have a degree of uncertainty associated with the quality data used in the modeling. Empirical-regression models are mainly plot-level models, while explanatory-simulation models are mainly process-level models. In the strictest sense, a model is only applicable at the level from which it is derived. There is no general agreement among researchers on how to deal with the scale problem, and while this situation persists, any policy formulated on regional impact assessment must acknowledge the uncertainty. Based on what is discussed in this report regarding air pollutant exposure and vegetation response, the following is recommended: (1) The way to obtain a simple, single 'summary model', possibly for regional scale applications, is to start with a 'comprehensive' computer simulation of the biology (all the relevant components and processes, as they are known to function). This is then used to derive the 'summary mode' equation(s), from the behavior and sensitivity analysis of variables in the comprehensive model; (2) Summary models should be structured in terms of the probabilities of responses derived from probability density functions of the input parameters and forcing functions; (3) Due to the lack of decisive evidence demonstrating direct vegetation effects induced by acid aerosols or acidic precipitation under field conditions, no models should be considered at this time for these parameters; (4) For gaseous pollutant effects on plants, the models of Coughenour, SILVA, and SUCROS are good starting points. Summaries of these models are described in the appendices of this report. (See W89-08487 thru W89-08491) (Lantz-PTT)
W89-08492

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 5: EFFECTS OF ACID DEPOSITION ON SOILS IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
L. W. Turchenek, S. A. Abboud, C. J. Tomas, R. J. Fessenden, and N. Holowaychuk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-143474, price codes: E08 in paper copy, A01 in microfiche. 202p, 23 fig, 47 tab, 245 ref.

Descriptors: *Acid rain effects, *Environmental effects, *Soil contamination, *Alberta, *Canada, Literature review, Soil properties, Hydrogen ion concentration, Ion exchange, Geochemistry, Nutrients, Research priorities, Nitrates, Soil water, Leaching, Sulfates, Aluminum.

A review of the literature reflects the present state of knowledge of the short-term and long-term effects of acidic and acid forming substances from the atmosphere on soils, with particular emphasis on relating that literature to Alberta agronomic and forest ecosystems. The present concepts of the nature of soil acidity and related soil properties are discussed. The influences of soil acidity and of atmospheric acid deposition on soil properties including changes in pH, acid neutralizing capacity, ion exchange properties, organic matter, biogeochemical cycling, nutrient and toxic element availability are discussed. It is recommended that soil acid deposition effects be investigated by modeling because of the capability it provides for synthesizing information, identifying research needs, and predicting impacts. Models are required for soil response studies, but these should be developed primarily for interfacing with soil-plant response models and, via water and solute transport models, with lake-watershed acidification models. It is also recommended that: (1) research into SO2/NOx-soil interactions be undertaken; (2) research on acid deposition impacts on soil acidity, base status, and related soil chemical properties be undertaken; (3) solubilization and movement of Al and other toxic elements in soil be investigated in relation to acid deposition; (4) research into biogeochemical cycling in ecosystems be carried out; and (5) research on soil moisture regimes in relation to acid deposition and leaching effects be conducted. (Lantz-PTT)
W89-08503

INITIAL EVALUATION OF PHOTOGRAPHIC DATA OF F- AND H-AREA SEEPAGE BASIN OUTCROPS,
Savannah River Lab., Aiken, SC. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W89-08506

FISH ACUTE TOXICITY SYNDROMES: APPLICATION TO THE DEVELOPMENT OF MECHANISM-SPECIFIC QSARS (QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIPS),
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W89-08520

EFFECTS OF FLY ASH AND FLUE-GAS DESULFURIZATION WASTES ON GROUNDWATER QUALITY IN A RECLAIMED LIGNITE STRIP MINE DISPOSAL SITE. VOLUME II: APPENDICES,
North Dakota Mining and Mineral Resources Research Inst., Grand Forks.
F. W. Beaver, G. H. Groenewold, O. E. Manz, and D. J. Hassett.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-0011049. Price codes: A99 in paper copy, A01 in microfiche. Report No. DOE/FC/10120-2550, Vol. 2, August 1987. 603p, 6 append. DOE Contract AK18-80FC10120.

Descriptors: *Data collections, *Fly ash, *Chemical wastes, *Strip mine wastes, *Water pollution effects, *Groundwater pollution, Hydraulic conductivity, Groundwater quality, Piezometers, Lysimeters, Waste disposal, Disposal sites, Groundwater level, Water level, Hydrographs, Land reclamation.

The effects of fly ash and flue-gas desulfurization wastes on groundwater quality in a reclaimed lignite strip-mine disposal site were studied. Appendix A presents hydraulic conductivity data; Appendix B, groundwater quality analyses: analysis from piezometers, and analyses from pressure-vacuum lysimeters; Appendix C, stratigraphic position of piezometers and pressure-vacuum lysimeters; Appendix D, interstitial water chemical analyses; Appendix E, hydrographs of the piezometer water levels: wet-pit-bottom flue gas desulfurization (FGD) waste disposal setting, dry-pit-bottom FGD waste disposal setting, vee-pit FGD waste disposal setting, vee-pit fly ash disposal setting, and pit-bottom fly ash disposal setting; and Appendix F, water level data. (Lantz-PTT)
W89-08526

SALT MARSH MONITORING AROUND SULLOM VOE IN 1986,
Shetland Oil Terminal Environmental Advisory Group, Aberdeen (Scotland).
D. H. Dalby, and P. J. C. Tibbets.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-145933, price codes: E06 in paper copy, A01 in microfiche. 1987. 48p, 4 tab, 5 ref, 4 append.

Descriptors: *Salt marshes, *Succession, *Species Composition, *Monitoring, *Water pollution effects, *Oil pollution, Vegetation, Hydrocarbons, Sediment contamination, Alkanes, Aliphatic hydrocarbons, Shetland Islands.

Two visits were made to Shetland, in July/August and in October, 1986. Puccinellia maritima stolon lengths at the 'active' sites showed some variation in extension growth during the season, with little by way of a clear picture emerging. The pattern of growth at the 'inactive' sites had also been varied with two showing a significant increase, and two a significant decrease. P. maritima cover measurements were along marked transects on eight salt marshes; all but one showed no significant change. There was no biological evidence for damage having been caused to the salt marsh study sites during the preceding year as a result of activities at the oil terminal. The levels of total aliphatic hydrocarbons and unresolved complex mixture were in general lower than those observed in 1985, and were similar to those values observed in 1984. Sieving of sediments prior to extraction does not appear to alter the GLC distribution of the aliphatic hydrocarbon fraction, although concentrations are generally increased. This technique, however, is likely to improve year to year reproducibility of sample collection. Removal of the higher plant n-alkanes by urea adduction greatly facilitated the detection and accurate quantification of low levels of degraded petroleum input. (Lantz-PTT)
W89-08534

CALCULATION OF THE FINAL ACUTE VALUE FOR WATER QUALITY CRITERIA FOR AQUATIC ORGANISMS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
For primary bibliographic entry see Field 5G.
W89-08537

SUBLETHAL BIOLOGICAL EFFECTS MONITORING IN THE REGION OF SULLOM VOE SHETLAND, JULY 1986,
Institute for Marine Environmental Research, Plymouth (England).
J. Widdows, D. Dixon, P. Donkin, S. V. Evans, and D. Lowe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-147905. Price codes: E05 in paper copy, A01 in microfiche. March 1987. 19p, 3 fig, 9 tab.

Descriptors: *Water pollution effects, *Bioindicators, *Oil pollution, *Sublethal effects, Sullom Voe, Monitoring, Biological studies, Great Britain, Hydrocarbons, Oil spills, Aromatic compounds, Shetland Islands, Mytilus.

The overall objective of the field program is to use the common mussel Mytilus edulis, as a sentinel organism to monitor the sublethal biological effects of oil pollution in the littoral environment in the vicinity of the oil terminal at Sullom Voe, in order to detect any effects of industrial activity in the area. However, the 1986 mussel samples proved far from ideal for intercalibration purposes due to the low levels of petroleum contamination and presence of biogenic interferences. Nevertheless, mussels from Tanker Jetty 3 were the most contaminated, and those from Gluss Voe the least contaminated. The degree of oil contamination of the littoral environment around Sullom Voe appears to have declined between July 1985 and July 1986. These observations appear to be in agreement with the reduction in quantities of crude oil spilled at the Sullom Voe oil terminal during this period. However, a complete set of Sullom Voe oil pollution reports is not available at present. Calna Taing, the most contaminated site measured in 1985, following the 'BP Vision' spill, had considerably lower levels of contamination in July 1986 (i.e., 20% of 1985 values). This demonstrates the relatively rapid recovery of contaminated mollusks in littoral environments. Mussels from Gluss Voe

and Voxter Voe continue to have low and background concentrations of aromatic hydrocarbons in their tissues. There is generally little relationship between the concentrations of aromatic hydrocarbons accumulated in the body tissues of Mytilus (a suspension feeder in the surface waters) and the concentrations of petroleum hydrocarbons in the sediments of Sullom Voe. However, Garth's Voe was identified as the most contaminated area. Studies of embryo and larval development suggested that at the elevated concentrations of hydrocarbons found in the vicinity of the tanker loading jetties (i.e., at the lower 1986 levels) there were measurable toxic effects which need further investigation. (Lantz-PTT)
W89-08544

AMBIENT WATER QUALITY CRITERIA FOR SELENIUM-1987.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5G.
W89-08546

ALGAE AND THE ENVIRONMENT: THE GREAT LAKES CASE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer.
IN: Algae and Human Affairs. Cambridge University Press, New York. 1988. p 57-83, 1 tab, 7 fig, 107 ref.

Descriptors: *Algae, *Great lakes, *Limiting factors, *Nturients, *Eutrophication, *Water pollution effects, Nitrogen, Phosphorus, Silicon, Algal control, Algal growth, Lakes, Aquatic plants, Aquatic environment, Cyanophyta, Diatoms, Chrysophyta, Chlorophyta.

Algae have played an important role in some of the highly visible and publicly perceived problems in the Great Lakes. Due to the large surface area of the lakes and a large portion of the drainage area from bedrock types that are resistant to leaching, the dissolved constituents in the lakes are largely from rainfall. As a result the lakes are naturally deficient in phosphorus and silicon but relatively rich in nitrogen. In addition, the climate is important in controlling algal occurrence and abundance. Research carried out in the 1970's in response to obvious water pollution and algal growth problems indicated that phosphorus was the nutrient controlling algal production. It was further discovered that in addition to controlling the growth rate and standing crop of phytoplankton, phosphorus also controlled the availability of other nutrients. Increased phosphorus loading first results in secondary limitation by silicon. Nitrogen becomes secondarily limiting only in areas that receive high phosphorus loadings. Shifts in the type of algae present occur since different algae have specific nutrient requirements. Core studies indicate that human activities are not solely responsible for the dramatic changes in the lakes higher trophic levels. Their collapse may have resulted from fundamental changes in the ecosystem structure alone. Although phosphorus loadings to the lakes are decreasing, it is unlikely that the algal flora will return to previous patterns. The original nutrient balance cannot be restored rapidly, if at all, and new additions, planned and unplanned, of species not native to the lakes and synthetic compounds are likely to affect the biota. (See also W89-08612) (White-Reimer-PTT)
W89-08613

MARINE DINOFLAGELLATE BLOOMS: DYNAMICS AND IMPACTS,
Florida Dept. of Natural Resources, St. Petersburg, FL. Bureau of Marine Research.
K. A. Steidinger, and G. A. Vargo.
IN: Algae and Human Affairs. Cambridge University Press, New York. 1988. p 373-401, 1 tab, 175 ref.

Descriptors: *Red tide, *Algae, *Algal toxins, Dinoflagellates, Protogonyaulax, Dinophysis, Prorocentrum, Monitoring, Shellfish, Economic aspects, Argentina.

An overview of dinoflagellate blooms with emphasis on the distinctive cellular characteristics of dinoflagellates, the dynamics of bloom initiation and maintenance, and the ecological and economic impacts of such blooms is presented. Fronts and density gradients along water masses alter the migratory pattern, tactic behavior, and motility of dinoflagellates and can concentrate and restrict large populations to particular areas of the water column. Despite lower growth rates than diatoms and other phytoplankton, dinoflagellates maintain a competitive advantage through a combination of factors. The number of 'new' areas experiencing toxic red tides in the last 15 years has been substantial. The Argentina incident of paralytic shellfish poisoning is a typical example of: (1) the physical-biological interactions in red tides; (2) the need for biological monitoring; and (3) the need for public health monitoring of shellfish areas. It has been suggested that recurrent blooms of toxic dinoflagellates may be caused by resident cysts in sediments and that these seedbeds could and should be monitored. Toxic red tides can restructure marine communities through selective mortality. This perturbation alone, or in combination with other stresses, can adversely affect human economic systems. (See also W89-08612) (White-Reimer-PTT)
W89-08615

HAZARDS OF FRESHWATER BLUE-GREEN ALGAE (CYANOBACTERIA),
Alberta Univ., Edmonton. Dept. of Botany.
P. R. Gorham, and W. W. Carmichael.
IN: Algae and Human Affairs. Cambridge University Press, New York. 1988. p 403-431, 2 tab, 2 fig, 145.

Descriptors: *Water pollution effects, *Toxins, *Algae, *Cyanophyta, *Algal toxins, Anabaena, Microcystis, Oscillatoria, Gloeotrichia, Nodularia, Aphanizomenon, Gomphosphaeria, Alkaloids, Peptides, Algal growth, Eutrophication, Nuisance algae.

Episodes of poisoning by blue-green algae are unpredictable both in occurrence and duration. Toxins from freshwater blue-greens isolated and identified to date are alkaloids and low-molecular-weight peptides. The alkaloid toxins, produced by strains of Anabaena flos-aquae and Aphanizomenon flos-aquae, act more rapidly than the peptide toxins because they target the neuromuscular system. The low-molecular-weight peptide toxins act more slowly than alkaloid toxins because they target the liver causing extensive necrosis. They are known or suspected to be produced by several strains and six cyclic peptides have been identified from Microcystis aeruginosa and Anabaena flos-aquae. A number of other freshwater blue-green toxins have been recognized by signs and survival times produced when ingested by or injected into various animal species; however, many of these have not yet been isolated, and none has been chemically identified. Acute poisoning of humans is rare since people rarely drink water containing heavy concentrations of algae, but numerous cases of pets, livestock, and wildlife have been reported. Most blue-green blooms are nontoxic, but the environmental conditions that select for toxicity are not understood. Therefore, there is a degree of hazard in using them as a food source until rapid, sensitive, and reliable assay methods are developed to monitor the levels of toxins produced. (See also W89-08612) (White-Reimer-PTT)
W89-08616

EVALUATION OF COAL-MINING IMPACTS USING NUMERICAL CLASSIFICATION OF BENTHIC INVERTEBRATE DATA FROM STREAMS DRAINING A HEAVILY MINED BASIN IN EASTERN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08686

THEORETICAL TECHNIQUE FOR PREDICTING THE CUMULATIVE IMPACT OF IRON AND MANGANESE OXIDATION IN STREAMS RECEIVING DISCHARGE FROM COAL MINES,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08789

EFFECTS OF COAL STRIP MINING ON STREAM WATER QUALITY AND BIOLOGY, SOUTHWESTERN WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08801

ESTIMATING ECONOMIC IMPACTS OF SALINITY OF THE COLORADO RIVER,
Milliken Chapman Research Group, Inc., Littleton, CO.
L. C. Lohman, J. G. Milliken, W. S. Dorn, and K. E. Tuccy.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Final Report, February 1988. 95p, 12 fig, 18 tab, 38 ref, 2 append.

Descriptors: *Water pollution effects, *Salinity, *Economic aspects, *Colorado River, Computer programs, Reclaimed water, Water reuse, Industrial water.

Four interrelated studies, are reported: three that update or supplement the a previously published salinity damages data base and one to develop a computer program to estimate damages. The first study updated the agricultural and municipal damages data base established by Kleinman and Brown by: (a) considering current forecasts of the salinity concentration of Colorado River water available for use in the Lower Basin, including the impacts of the Central Arizona Project; (b) considering blending, water salvage and conservation scenarios that may affect future water use; (c) considering current economic conditions in terms of equipment and appliance lifetimes, costs and prices, interest rates, etc.; and (d) reexamining threshold values previously established for municipal, industrial, and agricultural damages. The second study examined and evaluated the benefits of reduced salinity of the Colorado River on reclaimed wastewater for direct and planned reuse in the Southern California water service area, as well as indirect or potential uses of such wastewater. The third study investigated industrial damages due to salinity, which were not addressed in earlier investigations, and established representative damages estimates for various industrial water uses. The fourth study involves development of a computer program that will permit easy calculation of salinity damages, by water use sector over various time periods, with varying assumptions of water use, population growth, and economic development and with the flexibility to make changes in such economic factors as costs, crop prices, and interest/discount rates. (Author's abstract)
W89-08979

SOME ASPECTS OF U.S. GEOLOGICAL SURVEY ACTIVITIES RELATED TO THE EFFECTS OF CONTAMINANTS ON WATER RESOURCES,
Geological Survey, Reston, VA. Water Resources Div.
B. K. Gilbert, W. B. Mann, and P. A. Emery.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-574, 1987. 63p, 3 fig, 1 tab, 17 ref, 2 append.

Descriptors: *Water pollution effects, *Data acquisition, *Budgeting, Costs, Surface water, Groundwater quality, Data collections, Project planning.

The U.S. Geological Survey's water resources programs are supported by direct annual appropriations from Congress, the Federal-State Cooperative Program (50:50 matching of funds), and by funds provided by other Federal agencies. For fiscal year 1987, total obligations exceeded $250 million for activities in every State, Puerto Rico, and several territories in cooperation with nearly

1,000 local, State, regional, and other Federal agencies. The quality of the ground and surface waters has been of concern to the Geological Survey from the time it was established. During the past few years, water resources contamination has received highest priority consideration and a variety of investigations and research are ongoing to obtain an improved understanding of the Nation's water quality and the factors affecting it. This report presents information on program priorities and discusses the coordinated activities focusing on the effects of contaminants on water resources. The report also describes a number of investigations and research activities in progress during fiscal years of 1986 and 1987, and provides guidance on how to obtain additional details. (Author's abstract)
W89-09008

POTENTIAL IMPACTS OF DISCHARGING TERTIARY-TREATED WASTEWATER INTO PORT ROYAL SOUND, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5E.
W89-09030

INDEX TO LIMNOLOGICAL DATA FOR SOUTH-CENTRAL ALASKA LAKES,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09269

5D. Waste Treatment Processes

INVESTIGATION OF AQUATIC MACROPHYTE-BASED AQUATIC WASTEWATER TREATMENT SYSTEMS FOR TEMPERATE CLIMATES,
New Hampshire Univ., Durham. Graduate School.
T. T. Eighmy.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8621599. Ph.D. Dissertation, 1986. 217p, 33 fig, 46 tab, 23 ref, append.

Descriptors: *Wastewater treatment, *Macrophytes, *Aquatic plants, *Nitrification, *Phosphorus removal, Effluents, Biological oxygen demand, Pilot plants, Secondary wastewater treatment.

A pilot-scale aquatic macrophyte-based aquatic treatment system was designed to treat primary effluent to advanced secondary treatment standards under temperate climate conditions. Four macrophytes were evaluated. The hydraulic, organic, and nutrient loading rates were similar to those for water hyacinth-based systems. Elodea nuttalli was the best candidate in that it was productive year-round and resistant to fouling by filamentous green algae. Ceratophyllum demersum and Myriophyllum heterophyllum, while providing surface area for epiphytic heterotrophs and nitrifiers, were not as effective in removing phosphorus from the waste stream and were excessively fouled so that productivities were usually negative. Lemna minor, while productive year-round, was essentially a two dimensional fixed-film system, which promoted anaerobic conditions below the floating mat so that effluent quality was poor. Percent removal of wastewater constituents in the Elodea reactors were biological oxygen demand 5, 77-97%, total nitrogen, 18-72%; and total phosphorus, 23-42%. Constituent removal rates were comparable to those of hyacinth-based systems for treatment of primary effluent. (Cremmins-AEPCO)
W89-08241

METAL ION REMOVAL ON A PRECOATED RETICULATED VITREOUS CARBON ELECTRODE,
North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
J. L. Ayres.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8701740. Ph.D. Dissertation, 1986. 199p, 56 fig, 29 tab, 91 ref, 3 append.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Deposition, *Electrodes, Carbon, Coatings, Precipitation, Ions.

The effect of metal precoatings on the removal of a metal ion from wastewater electrodeposition onto a precoated electrode was studied. Precoating candidates were screened based on current-voltage relationships in treating dilute metal ion solutions (10 mg/l) and the current efficiency of the precoatings chosen from the screening were evaluated in a flow-through reactor. The optimal electrode surface in treating multiple metal solutions was evaluated in a flow-by reactor. Operating and chemical costs of electrodeposition were compared to those for conventional precipitation. In general, the optimum choice of treatment by electrodeposition or precipitation is determined by the concentration of metal in the wastewater, toxicity of the metal, government regulations, the value of the recovered metal, complexity of operation, reliability of the treatment scheme, and the economics of the treatment method. A combination of treatments may be warranted for a given metal removal problem. (Cremmins-AEPCO)
W89-08256

METHOD AND APPARATUS FOR THE DISINTEGRATION AND DESTRUCTION OF HAZARDOUS AND TOXIC SLUDGE MATERIALS,
D. Roslonski.
U.S. Patent No. 4,655,932; April 7, 1987, 5p, 1 fig. Official Gazette of the United States Patent Office, Vol 1077, No 1, p 365-366, April 7, 1987.

Descriptors: *Patents, *Wastewater treatment, *Toxic wastes, *Hazardous materials, *Sludge, Dewatering, Sterilization, Electrolytes, Microorganisms, Pathogens, Filtration, Compaction, Heavy metals, Particulate matter.

Sludge containing toxic and hazardous materials are dewatered to about 100% solids, sludge pathogens and microorganisms are sterilized, and the remaining solid particles are disintegrated. The sludge is blended with an electrolyte in the blending station before the sludge and electrolyte are continuously passed to a filter unit for the dewatering of the sludge to a predetermined solid minimum. The dewatered sludge and electrolyte are then passed through a rolling mill to compress the sludge and electrolyte to a desired thickness as filter cake. The cake passes through a sensing station to determine the amount of electrolyte in it and its conductivity. The filter cake and the electrolyte are fed into a chamber and subjected to an automatically-adjustable high voltage, which causes disintegration of the filter cake. Inert gas, ozone, or other selected gases are introduced into the chamber for the sterilization of pathogens and microorganisms and the oxidation of toxic substances, particularly heavy metals. The particulate matter are subjected to a pulverizing mill for reduction to granular form. (Cremmins-AEPCO)
W89-08267

APPARATUS FOR FINAL CLEARING OF WASTEWATER,
R. von Nordenskjold.
U.S. Patent No. 4,448,689; May 15, 1984, 9p, 3 fig. Official Gazette of the United States Patent Office, Vol 1042, No 3, p1178, May 15, 1984.

Descriptors: *Patents, *Clarification, *Wastewater treatment, *Sludge, *Wastewater facilities, Settling tanks, Conveyance structures, Water conveyance.

Sludge from wastewater is cleared using a downwardly tapering collecting basin to which the wastewater is fed through at least one inlet. A conveyor cooperable with the lower area of the basin conveys sludge and wastewater upwardly to a sludge pipeline for the discharge of the separated sludge and an overflow receptacle receives the cleared wastewater. The floating arrangement of the apparatus not only maintains a constant overflow rate, but also maintains the collecting basin in a constant and established relationship with respect to the water level. The entire arrangement automatically adjusts to all water level variations, such as the quantity of wastewater provided daily or environmental influences. The collecting basin may be made of metal. The pressure in the basin is always the same as that on the outside so that forces resulting from pressure differences need not be absorbed. If servicing of the final clearer should become necessary, it can be lifted from the basin with the help of a crane or can be pulled over the bank. (Cremmins-AEPCO)
W89-08268

DECONTAMINATION OF RADIOACTIVELY CONTAMINATED LIQUIDS,
Carolina Power and Light Co., Raleigh, NC.
C. E. Robertson.
U.S. Patent No. 4,681,705; July 21, 1987, 6p. Official Gazette of the United States Patent Office, Vol 1080, No 3, p 1444-1445, July 21, 1987.

Descriptors: *Patents, *Decontamination, *Wastewater treatment, *Radioactive wastes, *Organic wastes, *Waste disposal, Separation techniques, Chelating agents, Nuclear powerplants, Lubricants, Particulate matter.

Mixtures of radioactively contaminated water and water-immiscible organic liquids, including lubricating oils, are decontaminated to produce an organic liquid for disposal in a conventional manner. A discontinuous mixture of the contaminated water and liquids is separated so that the organic liquid comprises a continuous phase in a wastewater fraction carrying metal radionuclides and an organic liquid fraction carrying metal radionuclides. The wastewater fraction is decontaminated and the radioactively contaminated organic liquid fraction is mixed with an aqueous solution of a water-soluble chelating agent until water-soluble metal-chelate complexes form between the chelating agent and substantially all of the metal radionuclides carried by the organic liquid fraction. The aqueous solution is separated from the organic liquid fraction to remove the water-soluble metal-chelate complexes containing substantially all of the radionuclides from the organic liquid fraction. This separation results in an organic liquid that is substantially free of radionuclides and is safely disposable by conventional methods. The aqueous solution is then decontaminated. (Cremmins-AEPCO)
W89-08269

TREATMENT SYSTEM FOR LANDFILL LEACHATE,
R. L. Lavigne.
U.S. Patent No. 4,678,582; July 7, 1987, 7p, 2 fig. Official Gazette of the United States Patent Office, Vol 1080, No 1, p 325-326, July 7, 1987.

Descriptors: *Patents, *Biological wastewater treatment, *Sanitary landfills, *Leachates, *Microorganisms, Grasses, Cation exchange, Wastewater disposal.

Leachate tolerant plant microorganisms and cationic exchange sites on organic media are used to treat sanitary landfill leachate. Reed canary grass (Phalaris grundinacea) was selected because of its effective absorption of heavy metals, its tolerance to saturated environments, and the production of oxygen as part of its natural metabolic activities. The leachate treatment system comprises a leachate supply source, a treatment basis which slopes from a high end to a low end and which includes a water impervious liner, and a particulate treatment medium, which includes peat moss to provide a large surface area to enhance the fixation and proliferation of microbes and to support plants for growth. The leachate tolerant plants grow in the treatment medium. An inlet flow control connected to the leachate supply and the treatment basis comprises a perforated tube at the high end of the treatment medium, a conduit connecting one end of the tube to the leachate supply source, and a flow control valve in the conduit for introducing leachate to the upper portion of the medium at the high end of the basin. An outlet flow control system drains the treated leachate from the

medium at the low end of the basin and collects the drained treated leachate. (Cremmins-AEPCO)
W89-08270

BIOLOGICAL FILTER HEATING ARRANGEMENT FOR TREATMENT OF WASTEWATER,
Ekofinn Oy A.B., Lahti (Finland).
A. Salokangas.
U.S. Patent No. 4,693,816; September 15, 1987, 4p, 1 fig. Official Gazette of the United States Patent Office, Vol 1082, No 3, p 1425-1426, September 15, 1987.

Descriptors: *Patents, *Biological wastewater treatment, *Wastewater treatment, *Heating, *Heat exchangers, Wastewater facilities, Biofilters, Biological filters.

A heater for outdoor air introduced into a biological filter for wastewater treatment consists of intake openings, a heat exchanger, a blower, and exhaust openings. The heat exchanger is mounted within the filter and connected to the intake openings for heating the outdoor air. Connected to the heat exchanger, the blower blows the heated air through a layer of filter material within the filter. The warmer side of the heat exchanger is in direct contact with the wastewater flowing in the filter, which allows the outdoor air within the exchanger to be heated directly by the heat transferred from the wastewater. The exchanger comprises an aluminum hose, which interconnects the intake openings and the blower and which is fitted so that it is at least partially immersed in the wastewater flowing in the filter. (Cremmins-AEPCO)
W89-08271

WATER TREATMENT APPARATUS,
Walker Process Corp., Aurora, IL.
C. P. Thissen.
U.S. Patent No. 4,522,714; June 11, 1985, 8p, 7 fig. Official Gazette of the United States Patent Office, Vol 1055, No 2, p 767-768, June 11, 1985.

Descriptors: *Patents, *Biological wastewater treatment, *Wastewater facilities, Water tanks, Plastics.

A wastewater treatment facility consists of a tank, a rotary biological contactor, and a hollow shaft. The tank contains an inlet and outlet and end and side walls, which confine the wastewater to a predetermined depth in the tank. The rotary biological contactor in the tank houses the rigid and hollow shaft, which extends horizontally. A water treating plastic media rotates on the shaft. The media peripherally embraces the shaft and contains gas and water passages, which are alternately filled and purged of gas and water as the media revolve. The hollow shaft has closed ends in the tank, confronts the tank end walls, and buoyantly floats the entire contactor in the wastewater with the shaft submerged. Mechanically bearings stabilize the contactor in the water. (Cremmins-AEPCO)
W89-08275

MEMBRANE FOR REVERSE OSMOSIS AND METHOD OF MAKING THE SAME,
Juichiro Ozawa (Japan). (Assignee).
For primary bibliographic entry see Field 3A.
W89-08282

SEMIPERMEABLE MEMBRANES,
Bayer A.G., Leverkusen (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W89-08283

PROCESS FOR DEWATERING MUNICIPAL AND OTHER SEWAGE SLUDGES,
'Licencia' Talalmanyokat Ertekesito Es Innovacios Kulkereskedelmi Vallalat, Budapest (Hungary). (Assignee).
I. Zagyvai, A. Gai, J. Merai, and D. Szamosi.
U.S. Patent No. 4,675,114; June 23, 1987, 5p. Official Gazette of the United States Patent Office, Vol 1079, No 4, p2153, June 23, 1987.

Descriptors: *Patents, *Wastewater treatment, *Dewatering, *Sludge drying, *Municipal wastewater, *Sewer systems, Separated sewers, Centrifugation, Flocculation, Organic waste.

Municipal and other sewage sludges containing fat and proteinic organic contaminants are dewatered and the solid particles in the sludge are separated from the aqueous phase. The pH of the sludge is adjusted between 9 and 12 by adding at least one compound from the group consisting of calcium hydroxide, calcium oxide, magnesium hydroxide, or magnesium oxide. The sludge is then mixed with 50 to 5000g/cu m of formaldehyde. A dusty or granular adsorbent, capable of adsorbing oils and fats, is added to the sludge in an amount of 0.5 to 15% by weight as calculated for the dry substance content of the sludge. The sludge is then treated with 20 to 500 g/cu m of a polymer flocculating agent having a molecular weight of at least 100,000 and is allowed to settle before water is removed from it by filtration or centrifuging or both. (Cremmins-AEPCO)
W89-08295

PHOSPHORIC ACID/LIME HAZARDOUS WASTE DETOXIFICATION TREATMENT PROCESS,
Deere and Co., Moline, IL.
G. R. Douglas, P. F. Kusy, and R. D. Grotelueschen.
U.S. Patent No. 4,671,882; June 9, 1987, 6p, 1 fig, 5 ref. Official Gazette of the United States Patent Office, Vol 1079, No 2, p994, June 9, 1987.

Descriptors: *Patents, *Wastewater treatment, *Heavy metals, *Phosphorus compounds, *Sludge drying, *Hazardous wastes, *Waste treatment, Phosphates, Precipitation, Coagulation, Dewatering, Hydrogen ion concentration, Lime.

A process was developed for producing a sludge from an aqueous solution with a leachability of less than that specified in the Resource Conservation Recovery Act. Phosphoric acid or an acid phosphate salt is added to the aqueous solution, which contains a heavy metal or an aggregate of heavy metals at a hazardous level, to precipitate the metals as metal phosphates. After the pH of the solution is lowered to less than 5.0, a coagulant is added to it to coagulate the precipitated metal phosphates. The pH of the solution is then raised to above 7.0 by adding an alkaline calcium source to form a nonhazardous sludge. This sludge is then dewatered. (Cremmins-AEPCO)
W89-08297

PRIMARY TREATMENT OF WASTEWATER,
National Starch and Chemical Corp., Bridgewater, NJ.
P. R. Kelly.
U.S. Patent No. 4,670,158; June 2, 1987, 5p, 1 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1079, No 1, p374, June 2, 1987.

Descriptors: *Patents, *Wastewater treatment, *Phosphorus compounds, *Primary wastewater treatment, *Lime, Polymers, Industrial wastes, Coagulation, Flocculation, Separation techniques, Spray irrigation, Organic wastes.

Wastewater containing an undesired level of suspended organic materials, comprising polymeric latex wastes and a solids content of about 0.05 to 5.0 weight percent, is treated by adding 0.02 to 0.20 weight percent lime to the wastewater. Phosphoric acid is also added in an amount sufficient to lower the pH to below 10.0, but not lower than 7.0. Flocculated solids sludge is separated and removed to obtain treated wastewater having a solids content of less than 0.05 weight percent. Up to 800 ppm of cationic or non-ionic polymer is added after the addition of the phosphoric acid and prior to adding an anionic polymer in an amount up to 100 ppm. The use of lime and phosphoric acid in controlled amounts in this primary wastewater treatment process yields high solids separation efficiencies and treated wastewater with desirable low solids and ionic content for further disposal by spray irrigation. (Cremmins-AEPCO)
W89-08298

FLOTATION PROCESS FOR THE CONTINUOUS RECOVERY OF SILVER OR SILVER COMPOUNDS FROM SOLUTIONS OR DISPERSIONS,
Agfa-Gavaert A.G., Leverkusen (Germany, F.R.).
M. Zlokarnik, G. Schindler, G. Koepke, and W. Stracke.
U.S. Patent No. 4,585,561; April 29, 1986, 9p, 5 fig. Official Gazette of the United States Patent Office, Vol 1065, No 5, p2367, April 29, 1986.

Descriptors: *Patents, *Separation techniques, *Silver, *Waste recovery, *Flotation, Bubbles, Proteins, Surfactants, Dispersants, Effluents, Halides.

Silver or silver halides are continuously separated from protein containing dispersions or effluents of silver or silver compounds containing at least about 100 ppm of gelatine. The pH of the dispersion is adjusted at or about the isoelectric point of the gelatine. Flocks are formed consisting essentially of the gelatine and silver or silver compounds by maintaining the pH of the dispersion at or about the isoelectric point in the presence of an effective amount of a cationically active polyelectrolyte to aid in separating the flocks. Finely divided inert gas bubbles are injected into the dispersion and the flocks are separated from the remaining dispersion by flotation. The desilverized effluent has a silver content of less than 1 mg of Ag/L. The amount of flotate is less than 2% of the amount of effluent introduced into the process. (Cremmins-AEPCO)
W89-08299

METHOD OF REDUCING THE NICKEL CONTENT IN WASTEWATER,
Texaco, Inc., White Plains, NY.
D. C. Vuong.
U.S. Patent No. 4,500,324; February 19, 1985, 5p, 1 tab. Official Gazette of the United States Patent Office, Vol 1051, No 3, p 1148-1149, February 19, 1985.

Descriptors: *Patents, *Wastewater treatment, *Waste recovery, *Nickel, *Industrial wastes, Separation techniques.

A method was developed for reducing the soluble and insoluble nickel containing impurities and any other water insoluble matter in a dilute wastewater stream comprising grey or blow-down water from a partial oxidation process for the production of synthesis, reducing, or fuel gas. Each liter of wastewater at a temperature of about 60 to 220 F is mixed with about 10 to 1000 mg of a water soluble material selected from the groups consisting of formaldehyde, ionizable polysulfide salt, and hydrogen peroxide. About 2 to 10 moles of dimethyl gloxime/atom of dissolved nickel is also mixed with the water. The pH of the dilute mixture is adjusted to a desired value in the range of 7 to 11, by the addition of a base material. A precipitate comprising nickel-dimethyl-glyoxime complex forms is separated from the water along with at least a portion of any other insoluble impurity, such as particulate carbon, soot, and the metals and sulfides of the metals V and Fe, using at least one conventional solids and liquid separator. Suitable solids and liquid separators may be selected from the group consisting of filter, centrifuge, hydroclone, settler, clarifier, or combination thereof. The nickel content of the wastewater is thereby consistently reduced to an environmentally acceptable discharge level, and nickel is prevented from building up in recycle circulating water systems. (Cremmins-AEPCO)
W89-08300

DRAINAGE TUBE,
A.A.R.C. (Management) Pty. Limited, Victoria (Australia). (Assignee).
For primary bibliographic entry see Field 4A.
W89-08301

METHOD OF REMOVING HEAVY METAL FROM WASTEWATER STREAMS,
CX/OXYTECH, Inc., Yorkville, IL.
G. S. Elfline.

U.S. Patent No. 4,678,584; July 7, 1987. 6p. Official Gazette of the United States Patent Office, Vol 1048, No 1, p 326, July 7, 1987.

Descriptors: *Patents, *Wastewater treatment, *Heavy metals, *Metal-finishing wastes, *Waste recovery, Precipitation, Sodium compounds, Sulfides, Industrial wastes.

Heavy-metals in liquids in wastewater streams are treated with sodium trithiocarbonate (Na2CS3) to precipitate the heavy metals as insoluble metal sulfides. In this solid form, the metal ions are easy to separate and dewater from the effluent through filtration, centrifugation, or clarification. After separation of the solid phase, the metal sulfides can be converted to metal oxides by subjecting them to a simple ore roasting process. The combined metal oxides can then be separated into the individual metals by standard methods and can be converted into economically useful forms. The process is useful on any heavy metal-bearing liquid, such as those obtained as waste products in metal finishing or plating, mining, or milling operations; on naturally occurring liquids, or any other liquid containing one or more heavy metal ions. (Cremmins-AEPCO)
W89-08303

REMOVAL OF IRON FROM CHELANT SOLUTIONS,
Dowell Schlumberger Inc., Tulsa, OK. (Assignee).
W. C. Kennedy.
U.S. Patent No. 4,629,570; December 16, 1986, 4p. Official Gazette of the United States Patent Office, Vol 1073, No 3, p1526, December 16, 1986.

Descriptors: *Patents, *Wastewater treatment, *Iron, *Separation techniques, *Liquid wastes, Chelating agents, Waste recovery, Iron oxides.

Iron is removed from an aqueous liquid waste containing dissolved iron in the form of soluble chelate or chelates using an alkylenepolyamine polyacetic acid and or soluble chelating salts of that acid. The pH of the aqueous liquid is adjusted to at least about 12.5 and sufficient quantities of a soluble calcium salt are added to facilitate the growth of insoluble colloidal iron hydroxide particles. The resulting insoluble mass containing iron hydroxide is separated from the liquid effluent. The process is highly effective in reducing the amount of dissolved iron in solution and the insoluble mass resulting from the process is easily separated from the liquid effluent. (Cremmins-AEPCO)
W89-08304

INVESTIGATION OF NOVEL ADSORPTIVE SEPARATION METHODS FOR REMOVAL OF TRACE HEAVY METALS FROM POLLUTED AREAS,
Idaho Univ., Moscow. Dept. of Chemical Engineering.
T. E. Carleson, and M. Moussavi.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115570/AS, price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Institute Completion Report, Moscow, May 1988. 23p, 2 tab, 8 fig, 3 ref. USGS contract 14-08-0001-G1419. USGS project G1419-07.

Descriptors: *Wastewater treatment, *Water treatment, Adsorption, Heavy metals, Groundwater, Separation techniques, Cadmium, Zinc, Heavy metals, Chelation, Trace metals, Idaho, Bunker Hill mine.

The removal of trace amounts of cadmium and zinc from wastewater samples from the Bunker Hill mine as well as from synthetic wastewaters was evaluated. The heavy metals were chelated with the surfactants, sodium lauryl sulfate, sodium lauryl benzene sulfate, and cetyl pyridinium chloride. The chelated metals were then separated by the generation of a foam by sparged air or dissolved air. As much as 95% of the metal entering the foam generation unit was removed and carried out with the foam. The foam generated constituted about 25% of the feed. The removal efficiency was correlated with feed flow rate and foam drainage height by means of a simple equilibrium model. Qualitative predictions based upon the model fit the experimental results although quanitative agreement was not good. Recommendations for further experimental work are presented. (USGS)
W89-08339

BISOLUTE ADSORPTION ONTO ACTIVATED CARBON IN A FIXED BED: IAST VS. SIAST,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. R. Yonge, and K. E. Hartz.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-121396/AS, price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, April 1986. 55p, 10 fig, 1 tab, 39 ref. USGS contract 14-08-0001-G1051. USGS project G1051-01.

Descriptors: *Adsorption, *Activated carbon, *Computer models, *Model studies, *Wastewater treatment, Diffusion, Homogeneous surface diffusion model, Ideal absorbed solution theory, Film transfer coefficient, Intraparticle diffusion coefficient.

Numerical modeling of onto adsorption activated carbon can be a valuable tool during activated carbon adsorber design and operation. Unfortunately, current predictive models are often restricted to certain system conditions and developmental assumptions. A model is needed which is applicable to a wide variety of conditions and is computationally efficient. The homogeneous surface diffusion model (HSDM) was evaluated for its sensitivity to model parameters and for the influence of the ideal adsorbed solution theory (IAST) and the simplified ideal absorbed solution theory (SIAST) on HSDM model prediction accuracy. Two dynamic model parameters were found to have an impact on HSDM response: the intraparticle diffusion coefficient and the film transfer coefficient. Of these two parameters, the film transfer coefficient had the most significant impact on HSDM performance; indicating that care must be taken when determining this model parameter. Additionally, for the data studied herein, the HSDM utilizing the IAST afforded better prediction accuracy than the HSDM utilizing the simplified IAST. For certain values of the Freundlich equation constants k and 1/n, however, the HSDM failed to converge. (USGS)
W89-08363

LABORATORY PLANNING FOR WATER AND WASTEWATER ANALYSIS,
Laboratory Consultants, Albuquerque, NM.
D. W. Clark.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-119556/AS, price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces Technical Completion Report No. M20, June 1988. 72p, 19 ref, 4 append. USGS state project 1345643.

Descriptors: *Wastewater treatment, *Design criteria, *Laboratory equipment, *Water treatment, Analytical techniques, Water analysis, Treatment facilities.

This project produced a laboratory planning handbook presenting comprehensive, standardized guidelines for water and wastewater treatment facilities. The handbook will assist design engineers, laboratory analysts and treatment plant personnel in designing, constructing, equipping and staffing water and wastewater treatment plant laboratories. Incorporated into the handbook are the technological advances in laboratory equipment and procedures made over the last decade. (Clark-UNM)
W89-08369

FEASIBILITY STUDY OF THE PRIVATIZATION OF PUBLIC WASTEWATER TREATMENT WORKS,
Auburn Univ., AL. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W89-08404

ZEOLITE AMMONIA REMOVAL FROM CATFISH POND WATERS,
Mississippi Univ., University. Dept. of Geology and Geological Engineering.
W. R. Reynolds, and C. W. Williford.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136857/AS, price codes: A03 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report G1431-05, July 1988. 16p, 25 fig, 11 tab, 8 ref, 4 append. USGS contract 14-34-0001-G1431. USGS project G1431-05.

Descriptors: *Zeolite, *Filtration, *Ammonia removal, *Wastewater treatment, Catfish ponds, Water purification, Water conservation, Water flow, Mississippi.

The catfish rearing industry has been a major contributor to a critical water table drawdown in the Mississippi Delta region. This is due to a high pumpage rate in order to maintain proper water quality in existing 20 acre ponds. The demand for catfish far exceeds production and the only recourse at present is to construct new ponds which in turn requires increased pumpage. The problem of fish production can also be resolved by increasing fish density in existing ponds. Unfortunately, increasing fish density would also produce toxic buildup of ammonia and nitrate. This problem, however, can be alleviated by employing an ammonia absorbing filtration system. Such a system consists of using the natural zeolite clinoptilolite as a molecular sieve for ammonia removal. The clinoptilolite used in mined at Death Valley Junction, CA, and has an excellent combination of cation exchange capacity (218 meq/100 gms) and slake durability (slake durability index of 98%). Packed column studies using the Death Valley Junction clinoptilolite produced flow rates from 50 to 300 bed volumes/hour using 1 mg/lt ammonia/L influent. Furthermore, low average effluent concentrations were achieved at less than 0.03 mg/lt ammonia. When testing this system in natural waters it was found that competing ions particularly, calcium and magnesium reduced the zeolite's capacity for ammonia sorption. Consequently, more frequent regeneration was required. High algal buildup typical in pond waters required frequent backflushing but did not hinder the overall operation. (USGS)
W89-08445

SUPERFUND RECORD OF DECISION: POWERSVILLE L.F., GA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220991. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-87/029, September 1987. 110p, 11 fig, 15 tab, 2 append.

Descriptors: *Municipal wastes, *Industrial wastes, *Water quality control, *Water pollution control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, *Georgia, *Landfills, Agricultural runoff, Pesticides, Hazardous wastes, Water pollution sources, Volatile organic compounds, Organic compounds, Heavy metals, Lead, Chromium, Costs, Path of pollutants.

The Powersville Landfill, which occupies approximately 15 acres, is located in Peach County, Georgia. General crop farming is the major agricultural practice in the region, however, cattle farms and orchards are also common. Locally the Providence aquifer system is a source of water for both consumption and irrigation. From the early 1940s to 1969 the landfill site was a borrow pit which provided sand and fill material to the County for local use. During 1969 Peach County began operating the site as a sanitary landfill receiving municipal and industrial wastes. In December 1972 the Georgia Department of Natural Resources Environmental Protection Division suggested the separation and maintenance of areas for pesticides and associated wastes which was attained. Disposal records indicate pesticide manufacturing wastes were disposed of in the municipal section of the

landfill prior to June 1973 and in the hazardous waste areas between June 1973 and 1978. Neither the quantity nor the location of the waste in the municipal landfill is known. The landfill was closed in 1979 due to its location in a highly permeable sand and gravel aquifer. The primary contaminants of concern affecting the soil and groundwater include: volatile organic compounds (vinyl chloride), heavy metals (lead and chromium) and pesticides. The selected remedial action for this site includes: surface capping of hazardous waste and municipal fill areas using artificial material or clay, with grading, drainage and closure; installation of eight additional monitor wells (at a minimum) in the upper region of the aquifer to determine cap area leaching or migration; and extension of the municipal water supply pipe line as an alternate water supply. The total present worth cost for this remedial action is $4,000,000 with present worth operation and maintenance of $577,013. (Author's abstract)
W89-08472

SUPERFUND RECORD OF DECISION: FMC CORP., MN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08473

SUPERFUND RECORD OF DECISION: SAND SPRINGS PETROCHEM, OK (SOURCE CONTROL O.U.).
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08474

SUPERFUND RECORD OF DECISION: WILLIAMS PROPERTY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08475

SUPERFUND RECORD OF DECISION: ROSE TOWNSHIP, MI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08476

SUPERFUND RECORD OF DECISION: STRINGFELLOW ACID PITS, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08477

SUPERFUND RECORD OF DECISION: SOUTH BRUNSWICK, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08478

SUPERFUND RECORD OF DECISION: PALMETTO WOOD PRESERVING, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08479

SUPERFUND RECORD OF DECISION: NEW BRIGHTON/ARDEN HILLS/TCAAP, MN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08481

SUPERFUND RECORD OF DECISION: CENTRAL CITY/CLEAR CREEK, CO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08482

COMPARISON OF LABORATORY PERFORMANCES,
Sandia National Labs., Albuquerque, NM. Environmental Programs Div.
For primary bibliographic entry see Field 5A.
W89-08493

GUIDE TO THE DEPARTMENT OF DEFENSE OPERATION, MAINTENANCE AND TRAINING ASSISTANCE PROGRAM (OMTAP) FOR WASTEWATER TREATMENT PLANT PERSONNEL.
Ciccone (V.J.) and Associates, Inc., Woodbridge, VA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A187 343. Price codes: A04 in paper copy, A01 in microfiche. June 1987. 72p, 1 fig, 5 append.

Descriptors: *Wastewater facilities, *Personnel, *Training, Maintenance, Performance evaluation, Wastewater management.

OMTAP is a Department of Defense program to improve the performance of wastewater treatment plants located on military installations. The program is divided into three phases, each requiring a site visit by a team of evaluators. The first phase involves a comprehensive evaluation of the treatment process to identify operational and/or design deficiencies. In the second phase, operators and laboratory technicians are trained in procedures recommended to overcome problems identified during the diagnostic phase. The final phase is a follow-on evaluation of plant performance to assess those improvements that have been made since OMTAP was initiated at the plant. (Author's abstract)
W89-08523

WASTEWATER AND HAZARDOUS WASTE SURVEY, ENGLAND AFB LA,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
F. E. Stavich, and C. Attebery.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A194 105. Price codes: A05 in paper copy, A01 in microfiche. Report No. 88-004EQ0062AWA, January 1988. 71p, 11 fig, 6 tab, 13 ref, 6 append.

Descriptors: *Louisiana, *Hazardous coastes, *Wastewater materials, *Hazardous wastes, *Water pollution treatment, Water quality control, Waste management, Arsenic, Cadmium, Benzene, Chlorinated hydrocarbons, Separation, Physical treatment, Surveys, Military reservations.

A wastewater characterization and hazardous waste survey was conducted at England AFB to address a compliance order given to the base by the State of Louisiana Office of Solid and Hazardous Waste. The compliance order identified several deficiencies in the England AFB hazardous waste program and asked the base to provide the City of Alexandria with analytical data regarding any and all discharges into the sanitary sewer system. The results of the hazardous waste survey showed the base hazardous waste program was running smoothly. The accumulation site managers have a good understanding of the overall waste management program. The base has effectively minimized solvent waste handling through the widespread use of Safety Kleen cleaning vats. The analytical results from the wastewater survey showed arsenic, cadmium, benzene, chlorinated benzene, and fuel components above the applicable discharge ordinance, City of Alexandria Local Ordinance 277.5-8. However, the concentrations of the chemicals were near the discharge limits. The results of the hazardous waste analysis showed the separator located outside the Armament Shop (building 2102) contained hazardous waste. Fire training pit operations could exceed the fire training pit oil/water separator capacity. Recommendations included: (1) wastestreams found to exceed the discharge ordinance should be resampled to confirm the chemical concentrations; (2) sludge from waterfall paint booths on England AFB should be tested for hazardous waste and disposed of accordingly; (3) a training program, integrating the technical expertise of the environmental engineers should be initiated to train shop personnel on the operating principles and limitations of oil/water separators; (4) waste floor polish remover should be discharged to the sanitary sewer, not the storm drainage system; (5) bioenvironmental engineering section personnel should establish a routine sampling protocol for hazardous waste and industrial wastestreams; and (6) England AFB should petition the State of Louisiana for a separate EPA identification number for the base's Lake Charles Radar Site. (Lantz-PTT)
W89-08525

TOXICITY REDUCTION EVALUATION AT THE PATAPSCO WASTEWATER TREATMENT PLANT,
Engineering Science, Fairfax, VA.
J. A. Botts, J. W. Braswell, E. C. Sullivan, W. L. Goodfellow, and B. D. Sklar.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220488. Price codes: A14 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/034, June 1988. 306p, 35 fig, 577 tab, 51 ref, 5 append. EPA Contract CR812790-01-1.

Descriptors: *Wastewater management, *Water pollution control, *Wastewater treatment, *Toxicity, *Water quality control, Baltimore, Maryland, Municipal wastewater, Organic compounds, Water pollution treatment, Volatilization, Ammonia, Bioassays.

In January 1986 the EPA and the City of Baltimore (City) entered into a cooperative agreement to perform a toxicity reduction evaluation (TRE) research study at the City's Patapsco Waste Water Treatment Plant (Patapsco WWTP). The Patapsco WWTP TRE was initiated in April 1986 and completed in September 1987, and represents one of the first case histories of a toxics management program at a municipal wastewater treatment plant. This study characterized treatment plant influent and operations data and related these data to wastewater toxicity and inhibition data; characterized the plant's influent and effluent wastewater toxicity using definitive EPA bioassays and in-plant toxicity monitors; evaluated the fate of toxicity and specific toxic chemicals during treatment; and evaluated techniques to trace toxicity to its source and to identify specific components of toxicity. Although the Patapsco WWTP performed well, a major reduction in toxicity was achieved by the Patapsco WWTP, substantial acute and chronic toxicity was present in the Patapsco WWTP effluent. The wastewater fractionation/identification procedures identified non-polar organic compounds as the principal toxicants while compounds removed by volatilization and ammonia contributed lesser amounts of toxicity. The toxicity treatability procedure was found to be an effective tool for identifying and ranking possible toxicity contributors and for identifying discharges that interfere with biological treatment. (Author's abstract)
W89-08531

TREATMENT OF MUNICIPAL WASTEWATERS BY THE FLUIDIZED BED BIOREACTOR PROCESS,
HydroQual, Inc., Mahwah, NJ.
O. K. Scheible, and G. M. Grey.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-140280. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/2-87/107, December 1987. 188p, 49 fig, 15 tab, 18 ref, 2 append. EPA Contract CS 808809.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Biological treatment, *Fluidized bed process, Pilot plants, Newburg, New York, Biological oxygen demand, Suspended solids.

A 2-yr, large-scale pilot investigation was conducted at the City of Newburg Water Pollution Con-

trol Plant, Newburg, NY, to demonstrate the application of the fluidized bed bioreactor process to the treatment of municipal wastewaters. The experimental effort investigated the ability of the process to treat municipal wastewater to secondary levels. Additionally, the studies evaluated the stability of the process under high hydraulic peak loads typical of combined sewer systems. An organic loading rate of 0.2 to 0.3 gm BOD/gm volatile suspended solids/day is suggested in order to meet secondary treatment levels. Suspended solids removals were relatively low through the reactor; the results indicate that final clarification would be required for the plant to meet a 30 mg/L TSS limitation. The system exhibited good stability under high short-term peak hydraulic loadings. Maximum to average raw flow ratios up to 5 could be handled without bed washout. Special reactor modifications to yield an expanded upper section allowed a ratio as high as 10 to 1 without loss of the bed. (Author's abstract)
W89-08547

ROLE OF MICROALGAE IN LIQUID WASTE TREATMENT AND RECLAMATION,
California Univ., Berkeley. Dept. of Civil Engineering.
W. J. Oswald.
IN: Algae and Human Affairs. Cambridge University Press, New York. 1988. p 255-281, 2 tab, 4 fig, 41 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Algae, Wastewater renovation, Wastewater lagoons, Wastewater oxidation, Algae harvesting, Algal growth, Nutrients, Feedlots, Feedlots wastes, Animal wastes, Fertilizers, Energy sources.

Based on a review of the applications of wastegrown microalgae it is apparent that where the climate permits their use, properly designed microalgal-bacterial systems are the most economical and reliable systems available for domestic sewage treatment and for treatment of industrial and agricultural organic liquid wastes. Biological processes are the only economical way to remove a significant fraction of dissolved organics from wastewater. Since organic animal wastes typically contain all the nutrients required by plants, they can support the growth of large concentrations of algae. In general, it is calculated that fast-growing algae can attain a dry weight concentration of 2.5 times C, 12 times N, and 100 times P if no other factors are limiting. Applied to animal feedlots, such systems could double the amount of fixed nitrogen recovered as a product from animal feeds and, in addition, produce a large surplus of electrical energy from the residues. Electrical power generation from nutrient-integrating algal-bacterial systems could provide a significant fraction of a community's electrical power needs in safe, ecologically sound systems. Despite fears of groundwater contamination, properly designed ponds can provide safe integrated algal-bacterial treatment. Although harvesting or removal of microalgae is a major cost in the use of algae for oxygenation, studies are underway to utilize the algae, perhaps as a methane source, to increase the cost effectiveness of the systems. (See also W89-08612) (White-Reimer-PTT)
W89-08614

CONTROL OF ORGANIC SUBSTANCES IN WATER AND WASTEWATER.
Noyes Data Corporation, Park Ridge, New Jersey. 1987. 459p. Edited by Bernard B. Berger.

Descriptors: *Water analysis, *Wastewater analysis, *Wastewater treatment, *Water treatment, Organic compounds, Drinking water, Separation techniques, Municipal wastewater, Industrial wastewater, Chemical treatment, Physical treatment.

Procedures for treating water and wastewater must meet stringent requirements for water quality. Detecting and measuring the unknown pollutant in water and wastewater is a major challenge, as is determining the effect of the pollutant. This book has fourteen articles, or chapters, each prepared by a specialist. Chapter 1, Fundamental Considerations in the Removal of Organic Substances in Water, is an examination of a wide spectrum of physical and chemical principles that are being used, are under study, or may in the future be adapted for use in the separation of organic pollutants in waters. Chapters 2,3,4, and 5 review the status of techniques for the separation or destruction of organic impurities in drinking water. Chapters 6,7,8, and 9 review current methods, old and new, and assess their potential role in the future control of the priority organic pollutants contained in municipal wastewaters. Chapters 10, 11, 12, 13, and 14 examine existing and proposed new methods for control of organic substances in industrial wastewaters. (See W89-08702 thru W89-08715) (Lantz-PTT)
W89-08701

FUNDAMENTAL CONSIDERATIONS IN THE REMOVAL OF ORGANIC SUBSTANCES FROM WATER-A GENERAL OVERVIEW,
Louis Koenig-Research, San Antonio, TX.
L. Koenig.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 1-25, 4 tab.

Descriptors: *Water treatment, *Research priorities, *Wastewater treatment, *Physicochemic treatment, *Chemical treatment, Thermodynamics, Molecular structure, Colloids, Physical treatment, Enzymes, Electrophoresis, Separation techniques.

Techniques currently in use for organics removal from drinking water and wastewater fall the broad categories of physical separation techniques and chemical mechanisms. The bulk of organic chemicals of industrial origin, are, in a sense, new to nature. The future of wastewater treatment maybe in one of the following fields: thermodynamics of molecules and reactions, thermodynamic data on organics, chemistry of surfaces, especially small size surfaces, colloid chemistry, solid state physics of catalysts and of organics, the nature of chemical bonding, enzyme catalysis and enzyme synthesis and tailoring, electrokinetics and electrophoresis, and exotic high energy oxidants. (See also W89-08701) (Lantz-PTT)
W89-08702

REDUCTION OF ORGANIC SUBSTANCES IN MUNICIPAL WASTEWATER BY BIOLOGICAL PROCESSES,
Notre Dame Univ., IN. Dept. of Civil Engineering.
R. L. Irvine.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 175-202, 8 fig, 4 tab, 22 ref.

Descriptors: *Municipal wastewater, *Biological treatment, *Organic compounds, *Wastewater treatment, Chemical reactions, Microbial degradation, Solubility, Adsorption, Volatility, Settlable solids, Floating, Suspension.

Wastewater contains a multitude of inorganic and organic compounds. The following are discussed: Technologies employed for removal of organics are selected according to the physical, chemical and biological properties of the organics present in the wastewater. Simply stated, organics may be either soluble or insoluble. Some of the solubles have surface active properties which make them amenable to adsorption on materials such as activated carbon; others are volatile; many serve as a food source for microorganisms. Some exhibit all three properties. In addition to being either adsorbable or consumable, the insolubles can either settle, float or remain in suspension. This chapter focuses on those soluble and insoluble organics that are removed in the biological process. (Lantz-PTT)
W89-08707

REMOVAL OF ORGANIC SUBSTANCES FROM MUNICIPAL WASTEWATERS BY PHYSICOCHEMICAL PROCESSES,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
W. J. Weber, and F. E. Bernardin.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 203-254, 24 fig, 8 tab, 118 ref.

Descriptors: *Wastewater treatment, *Organic compounds, *Municipal wastewater, *Physicochemical treatment, Physical treatment, Chemical treatment, Oxidation, Conversion, Separation, Adsorption, Ion exchange, Activated carbon.

Physicochemical treatment (PCT) processes are generally categorized as operations which effect removal and/or destruction of undesirable organic constituents in wastewater by means other than biological degradation or conversion. In this broad context, PCT embraces a wide range of both traditional and innovative technologies. PCT processes may be defined more pertinently as technologies which practically and economically supplement or replace conventional biological treatments to yield equivalent or improved removal of organic substances. The qualifiers--practically and economically--implicitly exclude a number of processes which, although technically capable of accomplishing treatment objectives, are impracticable for one reason or another. This chapter considers only processes which have been demonstrated on large scale--or at least proven promising on pilot scale--to be suitable for near-term application to municipal wastewater treatment. The methods reviewed include selected oxidation/conversion technologies, phase separation technologies, and adsorption/exchange technologies. Particular emphasis is placed on that process category which has most extensively demonstrated its feasibility for removal of dissolved organic substances; specifically, adsorption processes utilizing activated carbon. (See also W89-08701) (Lantz-PTT)
W89-08708

IMPACT OF ORGANIC SUBSTANCES ON MUNICIPAL WASTEWATER REUSE,
J. C. Morris, and J. F. Donovan.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 255-277, 3 fig, 6 tab, 31 ref.

Descriptors: *Water treatment, *Water reuse, *Organic compounds, *Wastewater treatment, *Municipal wastewater, Potable water, Health effects, Water quality, Water pollution prevention.

Municipal reuse, the need for control of organic substances in waters intended for reuse, quality requirements for organic substances, methods of control of organic substances, an assessment of present problems, and future outlook are discussed. With few exceptions, the development of municipal wastewater-reuse facilities and current research in this field have focused on reuse for nonpotable purposes. Nonpotable reuse can be defined as the substitution of 'reclaimed water' for waters of potable quality that are now being used for nonpotable purposes. Organic substances present in reclaimed water have not been considered an important factor in most reuse planning. Where reuse is projected for nonpotable purposes only, the presence of potentially harmful organic chemicals in the reclaimed water has not been found generally, to be of great consequence. Such is not the case, of course, where reuse for potable purposes is contemplated. Reclaimed water generated from domestic wastewaters and treated to sufficient levels may be of better quality than water taken from sources subject to heavy contamination from synthetic organic substances. Such reuse applications as urban landscape and agricultural irrigation, industrial processing (other than food processing), cooling, toilet flushing, most commercial applications (e.g., car washing), and recreation generally are not affected by the presence of organic material of the types and concentrations normally encountered in municipal secondary effluents. Only where irrigation is used on crops that are to be used for animal feed, or directly for human feed need there be a concern for human health. Up to now, most attention in such situations has been given to concentrations of heavy metals, but as the number of reuse projects continues to grow, more attention needs to be given to the possible accumu-

lation of organic substances in crops and the significance of these substances both to the growth of the crops themselves and to the health of animals and humans who use these crops for food. (See also W89-08701) (Lantz-PTT)
W89-08709

MANAGEMENT OF RESIDUALS SEPARATED FROM MUNICIPAL WASTEWATER,
Cornell Univ., Ithaca, NY. Coll. of Engineering.
R. I. Dick.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 278-304, 1 fig, 1 tab, 105 ref.

Descriptors: *Waste management, *Wastewater treatment, *Municipal wastewater, *Sludge digestion, Sludge thickening, Sludge drying, Combustion, Biological treatment, Sludge conditioning, Pathogens, Viruses.

Sludge treatment processes include: thickening, dewatering, conditioning, drying, and dehydration. Processes altering sludge quality are: stabilization, combustion, inactivation of organisms and viruses, and detoxification. A common feature of nearly all processes used for treatment of municipal wastewaters is that they are intended to remove contaminants in the form of suspended solids. If a constituent that is to be removed does not exist as particulate matter, then chemical, physical, or biological means are used to make the constituent a part of a particle that can be removed by solids-liquid separation procedures. As a result of this approach, residues from municipal wastewater treatment consist of suspensions of particles in water. The residue is called 'sludge', and its management is a major challenge and expense in environmental quality control. Sludges from biological wastewater treatment consist principally of excess organisms synthesized in wastewater treatment. Additionally, a high degree of removal of the many pathogenic organisms and viruses contained in municipal wastewaters occurs during wastewater treatment, and, hence, such organisms and viruses are found in sludges. The organisms in sludge that may be pathogenic to humans include many species of bacteria, protozoa, and helminths (worms) together with human virus. (See also W89-08701) (Lantz-PTT)
W89-08710

REDUCTION OF ORGANICS BY BIOLOGICAL TREATMENT,
R. C. Loehr.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 305-336, 8 fig, 17 tab, 10 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Organic compounds, Aerobic treatment, Sludge digestion, Biological oxygen demand, Microbial degradation, Aeration, Activated sludge, Oxidation, Activated carbon, Sedimentation.

The majority of biological processes used to produce a well treated effluent are aerobic in nature. Examples include activated sludge units, trickling filters, aerated lagoons, oxidation ditches, and rotating biological contacting units. This chapter describes only the major aerobic processes (activated sludge, aerated lagoons, oxidation ponds, trickling filters, PACT (powdered activated carbon treatment) process, and sedimentation), effluent quality, the factors affecting removal of organics, and typical process performance. It also identifies the type and quantity of organics that can be removed from untreated industrial as well as municipal wastewater by typical aerobic biological treatment processes. Data indicate that: (1) well operated publicly operated treatment works (POTWs) remove variable but significant amounts of organic priority pollutants, (2) POTW effluents contain some organic priority pollutants in low concentrations (generally < 100 micrograms/L), and (3) many of the priority pollutants can be found in POTW sludges. Available information indicates that biological treatment processes can achieve high removals of both general organic pollutant parameters, such as measured by the BOD test, and specific organic compounds. In general, when high removals of BOD, COD and other general pollutants also occur. It is clear that microbial degradation is not the only mechanism of removal of organic compounds in biological treatment systems. Because of the aeration that takes place in such systems, air-stripping and volatilization as well as adsorption on suspended solids play a major role in the removal of organics. (See also W89-08701) (Lantz-PTT)
W89-08711

REMOVAL OF ORGANIC COMPOUNDS FROM INDUSTRIAL WASTEWATERS USING GRANULAR CARBON COLUMN PROCESSES,
Calgon Corp., Pittsburgh, PA.
R. P. O'Brien, J. L. Rizzo, and W. G. Schuliger.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 337-362, 10 fig, 6 tab, 13 ref.

Descriptors: *Organic compounds, *Adsorption, *Wastewater treatment, *Industrial wastewater, *Activated carbon, Hydrocarbons, Halogenated pesticides, Design criteria, Clarification.

During the last decade, adsorption using granular activated carbon gained wide acceptance for the removal of biorefractive and toxic dissolved organic compounds from industrial wastewater. It is the unit process of choice for the control of many of the hazardous and toxic organics among the priority pollutants, and particularly for the removal of the chlorinated hydrocarbon pesticides. Several innovations in the adsorption area took place during the early seventies. In 1970, a commercial application of the clarification/adsorption process for wastewaters was able to reduce suspended solids and oil and grease to 50 mg/L and 10 mg/L, respectively. This reduction is accomplished in conventional clarifiers with polymer addition followed by an adsorption system which removes the remaining suspended solids and dissolved organic contaminants. Prior to the announcement of this process, many studies clearly indicated that granular carbon was capable of serving the dual role of removing suspended matter and adsorbing the dissolved organics. Before granular activated carbon adsorption, wastewaters had to be pretreated if they contained high levels of suspended solids, insoluble oils and grease, and/or were chemically unstable. Activated carbon design options include: granular or powdered carbon, on-site or off-site regeneration, type of adsorption system, up-flow expanded bed, system configuration. Operating costs, energy requirements, and monitoring techniques are also discussed in this chapter. (See also W89-08701) (Lantz-PTT)
W89-08712

SEPARATION OF ORGANIC SUBSTANCES IN INDUSTRIAL WASTEWATERS BY MEMBRANE PROCESSES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
R. F. Probstein, C. Calmon, and R. E. Hicks.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 363-391, 113 fig, 5 tab, 46 ref.

Descriptors: *Separation techniques, *Organic compounds, *Industrial wastewater, *Wastewater treatment, *Membrane processes, Reverse osmosis, Ultrafiltration, Permselective membranes.

Industrial wastewaters may be treated by several membrane processes. A membrane is a selective barrier that permits some entities to pass through it while preventing the passage of others. The three principal membrane separation processes are reverse osmosis, ultrafiltration, and electrodialysis. Of the three, ultrafiltration bears the closest resemblance to ordinary filtration, in that the process is pressure-driven and the particle sizes held back by the membrane are determined by the membrane-pore sizes. Although reverse osmosis is also a pressure driven process, the controlling factor in particle-rejection is not size directly but generally relates to the diffusion properties of the molecules or ions in the membrane. In electrodialysis, under the action of a D.C. electric field, only dissolved ions are removed or concentrated from the bulk solution based on the selective character of the membrane with respect to particle charge. Since the particles must be charged, the utility of this method for organics separation is limited. One other membrane process applicable to organics separation is liquid-membrane permeation. This process employs a solvent in which an aqueous solution of caustic soda is emulsified. The emulsion employs a solvent in which an aqueous solution of caustic soda is emulsified. The emulsion acts as a one-way membrane that is permeable only to the organic by virtue of the organic reacting with the caustic soda and forming a compound which stays in place because it is not soluble in the solvent. (See also W89-08701) (Lantz-PTT)
W89-08713

IMPACT OF ORGANIC SUBSTANCES ON WASTEWATER RECYCLING IN INDUSTRY,
Camp Dresser and McKee, Inc.
R. H. Culver, and J. F. Donovan.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 392-407, 6 fig, 7 tab, 12 ref.

Descriptors: *Organic compounds, *Water reuse, *Industrial water, *Recycling, *Wastewater treatment, Waste recovery, Activated carbon, Reverse osmosis, Distillation, Electrodialysis, Chemical precipitation, Adsorption, Ion exchange, Operating costs.

Recycling of an industry's wastewater may meet all or a part of its water requirements. In internal reuse an industry uses a portion of its wastewater again for the same or some other in-plant function to reduce operating costs. The cost equation for water use and reuse has changed drastically in recent years. The cost of water is no longer just the cost of pumping it out of the ground or the nearest clean surface water source, plus the cost of cheap energy for heating or cooling if needed. It now includes the cost of expensive energy, the cost of treatment and disposal and the cost of bad public relations if excessive amounts are wasted. Recycling therefore is now perceived, in many situations, to be a cost-effective means for supplementing a plant's water requirements. Recycling can often reduce the cost of: (1) pumping fresh water (sometimes from great depths), (2) heating or cooling water, (3) treating and disposing of wastewater, and (4) pretreating wastewater before discharge to a publicly owned treatment works or paying penalties for excessive pollution loads. In some cases recycling is essential in meeting the plant's water needs. Industries must remove harmful materials, organic and inorganic, from their wastewaters to comply with the requirements of regulatory agencies. Since the cost of wastewater treatment is a fixed factor of operation the decision to reuse the treated water is easier to make. A number of processes are available for removing dissolved organic substances including: adsorption on activated carbon or polymeric adsorbents, distillation, reverse osmosis, ion exchange, electrodialysis and chemical precipitation. The use of activated carbon may involve either passing the wastewater through a bed of granular activated carbon or adding powdered activated carbon to the wastewater in a mixing tank and removing it with the adsorbed materials by coagulation, sedimentation and filtering. (See also W89-08701) (Lantz-PTT)
W89-08714

MANAGEMENT OF ORGANIC RESIDUALS SEPARATED FROM INDUSTRIAL WASTES,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
C. Lue-Hing, T. B. S. Prakasam, and D. Zenz.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 408-459, 28 tab, 41 ref.

Descriptors: *Organic compounds, *Waste management, *Industrial wastes, *Water quality control, *Legislation, Textile mill wastes, Gasoline, Oil industry, Oil wastes, Chemical industry.

A significant development in the strengthening of the control of water pollution in the United States was made in 1970 by consolidating various pollution control agencies spread throughout the Federal Executive Branch into one organization, the United States Environmental Protection Agency. The passage of the Federal Water Pollution Control Act in 1972, the Safe Drinking Water Act in 1974, the Toxic Substances Control Act (TSCA) in 1975, the Resource Conservation and Recovery Act (RCRA), in 1976, and the Clean Water Act in 1977 reflected the nation's determination to control pollution. While the Federal Water Pollution Control Act and its amendments seek to remove pollutants from wastewater, the RCRA, and to a minor extent TSCA, provide measures for the regulation and the ultimate disposal of solid wastes and the residuals separated from wastewater streams. In this chapter, some salient aspects of RCRA and a state-of-the-art of the treatment and disposal of organic residuals, particularly those which are hazardous and are separated from industrial wastes are discussed. Industries discussed are: textile industry, plastic materials and synthetics industry, paint formulating industry, petroleum refining industry, organic chemicals industry, explosives industries, food industry, pesticide application industry, drum reconditioning industry, and, gasoline service stations and related industries. (See also W89-08701) (Lantz-PTT)
W89-08715

RECONNAISSANCE OF SELECTED ORGANIC CONTAMINANTS IN EFFLUENT AND GROUND WATER AT FIFTEEN MUNICIPAL WASTEWATER TREATMENT PLANTS IN FLORIDA, 1983-84,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. B. Pruitt, D. E. Troutman, and G. A. Irwin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4167, 1985. 29 p, 7 fig, 5 tab, 13 ref.

Descriptors: *Wastewater analysis, *Wastewater facilities, *Wastewater treatment, *Organic compounds, *Surveys, *Groundwater pollution, *Municipal wastewater, *Pollutant identification, *Florida, Path of pollutants, Volatile organic compounds, Chlorination, Chloroform, Insecticides, Diazinon, Lindane.

Results of a 1983-84 reconnaissance of 15 municipal wastewater treatment plants in Florida indicated that effluent from most of the plants contains trace concentrations of volatile organic compounds. Chloroform was detected in the effluent at 11 of the 15 plants and its common occurrence was likely the result of chlorination. The maximum concentration of chloroform detected in the effluent sampled was 120 micrograms/L. Detectable concentrations of selected organophosphorus insecticides were also common. For example, diazinon was detected in the effluent at 12 of the 15 plants with a maximum concentration of 1.5 micrograms/L. Organochlorine insecticides, primarily lindane, were detected in the effluent at 8 of the 15 plants with a maximum concentration of 1.0 micrograms/L. Volatile compounds, primarily chloroform, were detected in water from monitor wells at four plants and organophosphorus insecticides, primarily diazinon, were present in the groundwater at three treatment plants. Organochlorine insecticides were not detected in any samples from monitor wells. Based on the limited data available, this cursory reconaissance suggests that the organic contaminants commonly occurring in the effluent of many of the treatment plants are not transported into the local groundwater. (Author's abstract)
W89-08746

5E. Ultimate Disposal Of Wastes

CHEMICAL BEHAVIOR OF PARTICULATE AND STABILIZED OIL ASH WASTE IN SEAWATER,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
V. T. Breslin.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8617385. Ph.D. Dissertation, 1986. 138p, 23 fig, 28 tab, 43 ref.

Descriptors: *Oil wastes, *Waste disposal, *Ocean dumping, *Seawater, Leaching, Model studies, Diffusion coefficient, Heavy metals, Chemical properties, Calcium, Arsenic, Copper.

The interactions of oil ash waste, particulate and stabilized, was studied in seawater to determine the acceptability of the waste in the ocean. The leaching behavior of vanadium is emphasized. Tank leaching studies were conducted to determine the release of major (calcium and vanadium) and minor (copper, nickel, and arsenic) elements from five stabilized oil ash mixes to seawater. Effective diffusion coefficients for calcium in these mixes ranged from 0.9 x 10 to the minus 9th power sq cm/sec to 210 x 10 to the minus 9th power sq cm/sec. Calcium diffusion coefficients decreased. At high pore water pH, calcium was removed from seawater and precipitated on the surfaces of oil ash blocks in the form of aragonite. Copper, cobalt, nickel and arsenic were effectively retained by the stabilized oil ash mixes. Vanadium release, however, was persistent. Effective diffusion coefficients for vanadium ranged from 0.67 x 10 to the 9th power sq cm/sec to 29.0 x 10 to the 9th power sq cm/sec for the five stabilized oil ash mixes. Vanadium release was influenced by pore water pH of the stabilized mixes and the cement content of the mix. Vanadium diffusion coefficients decreased with increasing pore water pH and as the cement content of mixes increased. (Cremmins-AEPCO)
W89-08247

DECONTAMINATION OF RADIOACTIVELY CONTAMINATED LIQUIDS,
Carolina Power and Light Co., Raleigh, NC.
For primary bibliographic entry see Field 5D.
W89-08269

TREATMENT SYSTEM FOR LANDFILL LEACHATE,
For primary bibliographic entry see Field 5D.
W89-08270

METHOD AND ARRANGEMENT FOR SEALING OFF DUMPS TO PREVENT SEEPAGE,
Zueblin (E.) A.G. Bauunternehmung, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-08280

HAZARDOUS ORGANIC WASTES FROM NATURAL GAS PRODUCTS PROCESSING AND DISTRIBUTION: ENVIRONMENTAL FATES,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5G.
W89-08348

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA, 1981-87,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08378

SUBSURFACE OF STORAGE OF LIQUIDS IN THE FLORIDIAN AQUIFER SYSTEM IN SOUTH FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
F. W. Meyer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Open-File Report 88-477, (1988). 72p, 10 fig, 7 tab, 26 ref.

Descriptors: *Underground storage, *Groundwater movement, Floridan aquifer system, Lower Floridan aquifer, Upper Floridan aquifer.

The Floridan aquifer system in south Florida is composed chiefly of carbonate rocks that range in age from early Miocene to Paleocene. The top of the Floridian aquifer system generally occurs at depths ranging from 500 to 1,000 ft, and the average thickness is about 3,000 ft. It is divided into three general hydrogeologic units that include Upper Floridan aquifer, the middle confining unit, and the Lower Floridan aquifer. Groundwater movement in the Upper Floridan aquifer is generally from the area of highest head in central Florida, eastward to the Straits of Florida, westward to the Gulf of Mexico, and, to a much lesser extent, southward. Injection of nontoxic liquid wastes into deep, saline parts of the Floridan aquifer system as a pollution-control measure began in 1943 with injection of oilfield brine in southwest Florida. Since then, the practice has quickly expanded, and many high capacity municipal and industrial injection wells are now in operation in southeast Florida. The principal use of the Floridan aquifer system in south Florida is for subsurface storage of liquid waste. The Boulder Zone of the Lower Floridan aquifer is extensively used as a receptacle for injected treated municipal wastewater, oilfield brine and, to a lesser extent, industrial wastewater. Pilot studies indicate a potential for cyclic storage of freshwater in the Upper Floridan aquifer in south Florida. (USGS)
W89-08385

EFFECTS OF TREATED MUNICIPAL EFFLUENT IRRIGATION ON GROUNDWATER BENEATH SPRAYFIELDS, TALLAHASSEE, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. B. Pruitt, J. F. Elder, and I. K. Johnson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4092, 1988. 35p, 14 fig, 7 tab, 45 ref. USGS project FL-419.

Descriptors: *Wastewater irrigation, *Spray irrigation, *Tallahassee, *Florida, Municipal wastewater, Water quality, Water pollution sources, Chlorides, Nitrates.

Groundwater quality data collection began in November 1979 at a spray-irrigation site near Tallahassee, Florida, before the initial application of secondary-treated municipal wastewater in November 1980. Effects of effluent irrigation on groundwater quality were evident about 1 year after spraying began and have continued to increase during the study period of 1983-85. Chloride and nitrate concentrations in groundwater have continued to increase since about 1 year after spraying began. Nitrate-nitrogen concentrations have increased from 0.03 mg/L to as much as 11 mg/L in water from one well in the surficial aquifer and from 0.07 to 15 mg/L in one well in the Floridan aquifer system. The greatest increases in concentrations have occurred in water from wells that top the surficial and Floridan aquifers. Increase in concentration occurred in water from some wells in the Floridan outside and downgradient of pivots, indicating lateral movement within the Floridan. The increase in sodium concentrations has been similar to the in chloride concentrations. Increases increases in the concentrations of other inorganic constituents have been minor compared to increases in chloride, sodium and nitrate concentrations. Nine volatile organic halocarbon compounds were detected in 18 effluent samples. Low concentrations of two of these halocarbons--chloroform and trichloroethene (TCE)--were detected intermittently in water sampled from six wells. None of the organic compounds detected in effluent or groundwater exceeded Florida drinking water standards. (USGS)
W89-08421

MODELS, DATA AVAILABLE, AND DATA REQUIREMENTS FOR ESTIMATING THE EFFECTS OF INJECTING SALTWATER INTO DISPOSAL WELLS IN THE GREATER ALTAMONT-BLUEBELL OIL AND GAS FIELD, NORTHERN UINTA BASIN, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08425

HAZARDOUS ORGANIC WASTE FROM NATURAL GAS PRODUCTS PROCESSING AND DISTRIBUTION: ENVIRONMENTAL FATES,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5B.
W89-08439

SUPERFUND RECORD OF DECISION: LASKIN POPLAR OIL, OH (2ND O.U.).
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08494

SUPERFUND RECORD OF DECISION: OPERATING INDUSTRIES, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08495

SUPERFUND RECORD OF DECISION: MARION/BRAGG LANDFILL, IN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08497

ELECTRICAL LEAK LOCATION METHOD FOR GEOMEMBRANE LINERS,
Southwest Research Inst., San Antonio, TX.
G. T. Darilek, and J. O. Parra.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220496. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/035, June 1988. 155p, 76 fig, 3 tab, 6 ref, 4 append. EPA Contract CR-811771-01-3.

Descriptors: *Leakage, *Testing procedures, *Water pollution prevention, *Hazardous wastes, *Geomembrane liners, *Landfills, *Liners, Polymers, Infiltration, Model studies, Drainage, Electrical studies.

An electrical method for detecting and locating leaks in geomembrane liners for hazardous waste impoundments and landfills was developed and successfully demonstrated for a wide variety of applications. Geomembrane liners are sheets of polymeric materials used to prevent the leakage of waste and to prevent rainwater from infiltrating solid waste landfills and surface impoundments. When no leaks are present, a voltage applied between the material in the liner and the earth under the liner produces a relatively uniform electrical potential distribution in the material in the liner. Leaks are located by mapping the anomaly in the potential distribution caused by current flowing through a leak. Tests on a small-scale double-lined model demonstrated the applicability of the method to a wide variety of double liner configurations of drainage layers with various test parameters such as leak size, electrode depth, and protective soil cover. Leaks in the top liner were easily detected and located. Leaks smaller than 0.8 mm in diameter were reliably located. Leaks in the bottom liner were detected, but not located. (Author's abstract)
W89-08527

SUPERFUND RECORD OF DECISION: LIQUID DISPOSAL, MI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W89-08530

INLAND WATERWAYS: PROCEEDINGS OF A NATIONAL WORKSHOP ON THE BENEFICIAL USES OF DREDGED MATERIAL.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-166698, price codes: A14 in paper copy, A01 in microfiche. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. 312p. Edited by Mary C. Landin.

Descriptors: *Spoil disposal, *Beneficial use, *Dredging, *Workshops, *Inland waterways, Ecosystems, Conferences, Canals, Management planning, Waste disposal, Interagency cooperation, Great lakes, Cost sharing, Public relations.

A national workshop featuring beneficial uses of dredged material in inland waterway systems of the U.S. was held in St. Paul, MN, on 27-30 October 1987. Technical sessions on aquatic habitats; habitat development case studies; innovative uses and concepts; recreation, commercial, and industrial applications; and the Great Lakes and their unique opportunities for beneficial use applications were held. Attendees also met in informal breakout sessions to discuss the direction each technical area should be taking and to make recommendations for development of each topic within inland waterways. Overall workshop recommendations included: (1) to continue to hold timely, informative workshops on beneficial uses in various parts of the U.S., with the next one located on the West Coast featuring coastal and marine environments; (2) to strive for maximum cooperation and communication between agencies and groups, including the formation of interagency working groups at the Corps of Engineers (CE) District level; (3) to work more closely with cost-sharing project sponsors to assist them in finding means to solve their erosion or stabilization and material placement problems in a cost-effective manner; (4) to encourage the development of long-term management strategies for dredging that incorporate both engineering and environmental realities; (5) to work harder to inform the general public on the positive aspects of using placement sites productivity; (6) to develop both formal and informal working agreements among agencies and groups to better accomplish the CE dredging mission; and (7) to continue to seek better means of dredging and placement and innovative uses of dredged material in inland waterway systems. (See W89-08556 thru W89-08571) (Lantz-PTT)
W89-08555

AQUATIC HABITAT DEVELOPMENT ON THE TOMBIGBEE RIVER, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
A. C. Miller, K. J. Kilgore, R. H. King, and J. C. Mallory.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 77-89, 5 fig, 16 ref.

Descriptors: *Aquatic habitats, *Lotic environment, *Spoil disposal, *Ecosystems, *Alabama, *Water resources development, *Ecological effects, Dredging, Tombigbee River, Gravel, Sand, Silt, Particle size, Aquatic environment, Fish, Invertebrates, Habitat development, Artificial shoals.

Ecosystems altered by construction of dams and channel diversions are now the most prevalent habitats on earth. This demand on lotic ecosystems has brought about an interest in habitat improvement and creation to offset losses. Sand and silt from maintenance dredging in navigable waterways have been used many times to develop wetland habitat or nourish beaches. In addition, submersed habitat (shoals and bars) can be created in navigable waterways with gravel or cobble. In March 1985, the Mobile Corps of Engineers District constructed two gravel bars in an abandoned channel of the Tombigbee River near Columbus, MS. This project had two objectives: (1) provide habitat for organisms that were more abundant in the river prior to construction of the Tennessee-Tombigbee Waterway; and (2) develop guidelines for aquatic habitat rehabilitation or improvement in navigable waterways using dredged material. These man-made gravel bars are not typical habitats. They are located in an abandoned channel immediately below a dam and protected from high flood-water velocities. A minimum release structure provides a continuous flow of water, and a gravel constriction maintains velocity at 45 cm/sec during normal and low flow. The following recommendations, based upon experience gained from this project, concern beneficial uses of dredged material: (1) although fine-grained material is not as suitable as gravel for many benthic invertebrates, fine-grained sediments can be used to construct aquatic habitats; (2) sand and silt can provide habitat for a dense community (usually with low species richness) of immature flies and aquatic worms. However, larger-sized particles are typically inhabited by a greater variety of species. Consideration should be given to enriching fine-grained sediments with large particles; (3) at Columbus, the majority of the biota reached the site within several months. Manmade aquatic habitats can provide a source of invertebrate food for fish and other higher organisms soon after construction; and (4) water velocity of 45 cm/sec will erode fine sand and silt, which can settle during periods of low flow. (See also W89-08555) (Lantz-PTT)
W89-08556

AQUATIC HABITAT CREATION ON THE OHIO RIVER, WITH REGULATORY CONSIDERATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
A. C. Miller, B. Stebbings, and R. Kanzinger.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 90-99, 5 fig, 12 ref.

Descriptors: *Legislation, *Regulations, *Aquatic habitats, *Inland waterways, *Ohio River, *Ecosystems, *Water resources development, *Ecological effects, Gravel, Particle size, Aquatic environment, Mussels, Macroinvertebrates, Dredging, Habitat development, Beneficial use, Artificial shoals.

Selected reaches of navigable waterways frequently have to be dredged to provide access to ports and loading facilities. Environmental legislation has encouraged beneficial uses of dredged silts and sands to create upland terrestrial or wetland habitats. Habitat creation techniques in navigable waterways are simple, operationally feasible, and should be considered when appropriate material and a suitable site are available. These habitats can be built with sediment from maintenance dredging, which often reduces material transport costs. When incorporated into early planning, habitat development can satisfy environmental concerns and meet project purposes. On the Kentucky side of the Ohio River across from Mound City (river mile 971.3-973.3) is an exposed shoal built from past maintenance dredging operations. A site with suitable depth and water velocity was selected at RM 972.0. Water velocity at the bottom ranged from 20 to 33 cm/sec during low flow, which is sufficient to keep the substrate free of fine sediments. It was determined that the gravel bar should measure 150 m long by 30 m wide. A structure this size is large enough to be found easily by divers and provides sufficient habitat for mussels and other macroinvertebrates. Enough material was obtained to construct a gravel bar that would be at least 25 cm deep. Most aquatic insects are in the top 5 cm of substrate, and freshwater mussels are usually in the upper 15 cm of a gravel bar. Construction techniques used to create the gravel bar, and continued monitoring plans, are described in this paper. (See also W89-08555) (Lantz-PTT)
W89-08557

RESULTS OF SALMONID FISH HABITAT RESTORATION WITH DREDGED MATERIAL IN THE CAMPBELL RIVER ESTUARY, BRITISH COLUMBIA, CANADA,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
C. D. Levings.

IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 100-104, 10 ref.

Descriptors: *Habitat restoration, *Trout, *Aquatic babitats, *Spoil disposal, *British Columbia, *Salmon, *Dredging, *Ecological effects, *Ecosystems, *Estuaries, Fish habitats, Vegetation establishment, Species composition, Water resources development, Fish, Gravel, Sand, Invertebrates.

In January-February 1982, four intertidal islands for the rehabilitation of salmonid habitat were constructed at the Campbell River estuary in British Columbia using gravel and sand dredged to build a new dryland sort. BC Forest Products, the Department of Fisheries and Oceans, and the Canadian Wildlife Service collaborated to build the islands which were part of a plan to recover a major portion of the estuary from log storage. About 26.0 ha of log storage area were given up and within this are 3.3 ha of intertidal islands were constructed. Cores of vascular plants from a donor site were planted on the islands, and provision was made to study colonization by plants and use of the habitats by invertebrates and juvenile salmon. Results to date indicate the restoration work at the Campbell River estuary has been successful, but considerable variation exists between habitats when results are examined in detail. The vascular plant community appears to be functioning quite well although further detailed comparisons are required with earlier estimates in 1976. The establishment and abundance of invertebrates since 1982 has also been variable with crustaceans, polychaetes, and insects dominating. The latter taxa appeared to be the earliest colonizer. The abundance of the total invertebrate community in 1986 was comparable to a reference site. Juvenile salmonids used the island habitats and were as abundant at certain island sites as at key reference stations. Feeding experiments showed the fish could feed on invertebrates produced on the islands. Island construction as a habitat restoration technique in estuaries should be reserved for areas where natural accretion is reduced, as was the case at Campbell River where a dam about 6 km upstream from the mouth has stopped gravel input since 1947. It is important to maintain or increase water volumes in estuaries as a strategy to provide proper fish habitat, but where possible, intertidal production could be augmented by construction of islands. (See also W89-08555) (Lantz-PTT)
W89-08558

DREDGED MATERIAL PLACEMENT IN THE LITTORAL ZONE AT LAKE OF THE WOODS, NORTHWESTERN MINNESOTA,
Army Engineer District, St. Louis, MO.
D. Wilcox.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 105-112, 4 fig, 2 tab, 3 ref.

Descriptors: *Spoil disposal, *Dredging, *Littoral zone, *Water resources development, *Ecological effects, *Lake of the Woods, *Minnesota, Warroad Harbor, Ecosystems, Birds, Aquatic vegetation, Vegetation, Water level, Habitat development.

Placement of hydraulically dredged material in the littoral zone of Lake of the Woods at Warroad Harbor, MN, was historically conducted by sidecasting material along the entrance channel. In 1983, dredged material from the channel entrance was deposited to form an island near the harbor mouth as a demonstration of habitat development in a large freshwater lake using dredged material. Open water discharge of dredged material resulted in temporary and localized water quality effects, and the dredged material was of such fine texture that it did not mound easily to form the island. This resulted in the island being built lower than originally planned. At the same time, unusually high lake levels during the summer of 1984 inundated the island, and wave action reconfigured the island into a lower, crescent shape. Material eroded from the island did not remain in the littoral sediment drift along the lakeshore but was redeposited into a semicircular sand flat lakeward of the island. High lake levels and wave action effectively removed all terrestrial vegetation from the island that grew in the first year. The dredged material deposit initially resulted in a net reduction in the areal extent of submerged aquatic plants, but aquatic plants subsequently recolonized much of the dredged material deposit, particularly between low lake bottom dunes that formed lakeward of the island. Lush submerged aquatic plants grew in the protected water landward of the island. Macroinvertebrates recolonized the dredged material deposit. Birds used the island extensively for roosting, but no nesting occurred there. The shallow flats around the island were used by shorebirds as water levels declined. Waterfowl fed in the protected area landward of the island. (See also W89-08555) (Lantz-PTT)
W89-08559

UPLAND HABITAT DEVELOPMENT ON DREDGED MATERIAL PLACEMENT SITES, UPPER MISSISSIPPI RIVER, POOL 18,
Army Engineer District, Rock Island, IL.
For primary bibliographic entry see Field 6G.
W89-08560

WETLAND AND UPLAND WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL DISPOSAL AREAS ON THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 6G.
W89-08561

RECLAMATION OF PYRITIC MINE SPOIL USING CONTAMINATED DREDGED MATERIAL,
Morton Arboretum, Lisle, IL.
G. Wilhelm, J. W. Simmers, R. Rhett, and J. M. Marquenie.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 160-176, 3 fig, 8 tab, 8 ref.

Descriptors: *Mine wastes, *Spoil banks, *Spoil disposal, *Land reclamation, Coal mining, *Ecological effects, Dredging, Polychlorinated biphenyls, Polyaromatic hydrocarbons, Revegetation, Cadmium, Heavy metals, Pyrite, Acid mine drainage, Succession, Path of pollutants, Bioassay.

Dewatered dredged material can be used effectively in the reclamation of pyritic mine spoil. The demonstration project described here showed that a cover of dredged material stopped acid runoff while allowing speedy revegetation. The vegetation now established at the site is changing in composition at a steady rate; pedogenesis is under way. How changes in contaminant movement will be expressed is the object of continued research as is research into how management protocols can be used to control these processes to produce positive results. Although some heavy metals, PCB's, and PAH's are present, there do not now appear to be any potential routes of contaminant uptake other than the movement of cadmium from leaf litter as indicated by the bioassay earthworms. The presence of low levels of contaminants in dredged material need not eliminate it from consideration for a productive use. However, it is necessary to conduct the appropriate bioassay monitoring procedures and to be prepared to implement appropriate management strategies consistent with the productive use. (See also W89-0855) (Lantz-PTT)
W89-08564

BENEFICIAL USES OF DREDGED MATERIAL IN SEVEN NEW ENGLAND PROJECTS,
Baystate Environmental Consultants, Inc., East Longmeadow, MA.
For primary bibliographic entry see Field 5G.
W89-08565

BENEFICIAL USES FROM DREDGED LAKE SEDIMENTS IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
W. P. Fitzpatrick, and G. E. Stout.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 184-191, 1 fig, 1 tab, 5 ref.

Descriptors: *Spoil disposal, *Beneficial use, *Waste recovery, *Lake restoration, *Water resources development, *Lake sediments, *Dredging, *Illinois, *Ecological effects, Agriculture, Construction, Mining, Land reclamation, Landfills, Strip mines.

The potential uses of dredged material are very broad, ranging from construction to agriculture to consumer products. In any given discipline that uses earth materials, some potential exists for discovering economic benefits from the abundance of dredged material that currently exists. In the history of industry and commerce, some of the most prominent success stories were achieved by finding a means of turning waste products into raw materials. The successes of using dredged material for agriculture, construction, brick-making, and other uses in Illinois are only a few potential successful uses. Among the many other uses that may be explored in the future are: (1) sanitary and hazardous landfill capping; (2) strip-mine reclamation; and (3) underground mine-subsidence control. In the future, it is likely that as more lake owners pursue dredging as a means of lake rehabilitation, the creative and entrepreneur energies of government and businesses will find additional means of exploiting this resource. (See also W89-08555) (Lantz-PTT)
W89-08566

UPPER MISSISSIPPI RIVER CHANNEL MAINTENANCE PLAN, BENEFICIAL AND PRODUCTIVE USE OF THE DREDGED MATERIAL,
Army Engineer District, St. Paul, MN.
D. J. Krumholz.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 192-198, 1 fig.

Descriptors: *Beneficial use, *Spoil disposal, *Mississippi River, *Channel improvement, *Dredging, *Ecological effects, Case studies, Sand, Inland waterways.

The St. Paul Corps of Engineers District is responsible for maintaining the northern 244 mi of the Upper Mississippi River 9-ft channel project from Minneapolis, MN, to Guttenburg, IA. Annual channel maintenance dredging averages 800,000 cu yd at approximately 25 different locations. The authorized project depth is 9 ft, but dredging is initiated when shoaling reaches 10.5 ft. Dredging depths range from 11 to 13 ft depending upon various hydraulic factors and operational considerations that influence the effectiveness and efficiency of maintaining the project depth. For the majority of the project, the authorized width is 300 ft with a provision for increased width on bends. If dredging requirements cannot be reduced or controlled, placement planning gives full consideration to beneficial uses of the material. Approximately 95% of the dredged material in the St. Paul District is uncontaminated medium-coarse sand. The District has provided dredged material for a variety of uses to other Federal and State agencies, counties, cities, private organizations, and private landowners. If a multiple demand exists and other considerations are equal, material is provided to the entity representing the larger public constituency. The material becomes the property and responsibility of the site owner. Case-by-case uses for the dredged material are highlighted in the discussion of this paper. (See also W89-)(Lantz-PTT)
W89-08567

INNOVATIVE RECREATION AND COMMERCIAL USES OF DREDGED MATERIAL ON THE TENNESSEE-TOMBIGBEE WATERWAY,

Army Engineer District, Mobile, AL.
For primary bibliographic entry see Field 6G.
W89-08568

OVERVIEW OF PAST AND POTENTIAL NATURAL RESOURCE BENEFICIAL USES OF DREDGED MATERIAL IN THE GREAT LAKES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
M. C. Landin.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 226-237, 6 fig.

Descriptors: *Spoil disposal, *Beneficial use, *Great Lakes, *Dredging, *Ecological effects, Water resources development, Disposal sites, Ecosystems, Wildlife habitats, Waterfowl, Recreation.

The Corps of Engineers (CE) dredged material sites throughout the Great Lakes are providing wildlife and fish habitats. Dredged material islands and site surveyed during the late 1970's found 100% of these sites in use by wildlife. The advent of Confined Disposal Facilities (CDFs) has only increased the use of a number of CE dredged material sites. All CDFs are receiving some level of wildlife and fish use, and over 30% of the new CDFs are being used as nesting-colony sites by waterbirds. CDFs are also providing mammalian and reptilian habitats due to their size and diversity. In addition to the habitats dredged material sites in the Great Lakes have provided, there is also a tremendous amount of natural resource-related recreation associated with them--fishing, hunting, boating, bird watching, hiking, biking, and nature trails. In short, the CDFs and other dredged material sites in the Great Lakes are serving as multiple use resources that benefit the people of the Great Lakes States and Provinces in many ways. (See also W89-08555) (Lantz-PTT)
W89-08569

OVERVIEW OF ALTERNATIVES FOR TOLEDO HARBOR, FOCUSING ON COMMERCIAL, AGRICULTURAL, AND UPLAND REUSE,
Toledo Metropolitan Area Council of Governments, OH.
E. J. Hammett, and J. Hull.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 244-250.

Descriptors: *Spoil disposal, *Harbors, *Recycling, *Alternative planning, *Toledo Harbor, *Dredging, *Ecological effects, *Management planning, Agriculture, Disposal sites, Environmental effects.

The Toledo Harbor has alternatives for dredged material disposal that appear to have environmental and other benefits beyond the traditional practices of open water disposal and in-water confinement facilities. Three constructive suggestions for the Corps of Engineers (CE) are recommended. (1) The ideas of long-term management plans are the logical approach to this type of problem and will result in overall lower costs. In Toledo, source reduction of sediment as a part of the strategy, can be included. These plans should be required for each harbor; (2) Recognizing that the CE must follow the authority that is legislatively provided, it must work to achieve greater flexibility in: the placement of non-hazardous polluted material in either confined disposal facilities (CDFs) or other reuse alternatives, the need to obtain credit for local sponsor-provided CDF space, consideration of multiple use benefits as erosion control at Woodtick Peninsula, and the dredging-program schedule, to consolidate work efforts into larger jobs that would allow the economics of scale to apply for certain alternatives; and (3) Reuse must be given a fair and objective analysis in comparison to other alternatives. (See also W89-08555) (Lantz-PTT)
W89-08570

BENEFICIAL USES OF DREDGED MATERIAL IN THE DEVELOPMENT OF TORONTO HARBOUR,
Environmental Protection Service, Toronto (Ontario). Ontario Region.
I. Orchard.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 251-262, 1 tab, 8 maps.

Descriptors: *Spoil disposal, *Harbors, *Beneficial use, *Land reclamation, *Parks, *Dredging, *Ecological effects, Toronto Harbor, Management planning, Recreation, Wildlife, Disposal sites, Dikes, Embankments.

There are generally five categories of direct and indirect beneficial uses accruing from disposal of dredged material. These are: (1) recreational, (2) industrial, (3) waterway development, (4) land reclamation and improvement, and (5) habitat development. Dredged material containment areas, either alone or in combination with other developments, have often been the location of waterfront parks. The East Headland and endikement has four significant components which have been created through the use of dredged material in combination with trucked fill. These components are the Outer Harbour East Headland, the Aquatic Park, the endikement, and the dredged material disposal cells. From 1961 to 1972, dredged material from Toronto Harbour was dumped in front of the advancing spit during construction of Aquatic Park. The Aquatic Park portion of the East Headland was created using trucked earth and rubble as well as sandy dredged material from the Outer Harbour-East Gap dredging operations in 1973 and 1974. Approximately 5 (million cubic yards) of dredged material was disposed in 1973 and 3.5 MCY in 1974. A total of 162.8 acres of land was created. The construction of the endikement began in 1979 on the south side of the East Headland using trucked fill to provide a disposal site for Inner Harbour dredged material. Dredged material exceeding open water disposal guidelines is placed in the containment cells of the endikement. Cell No. 1 is the innermost of the three cells and was filled 1.5 m deep in 1985. The actual amount of dredged material placed in Cell No. 1 was 365,441 cu m. Cell No. 2 has an estimated capacity of 530,000 cu m. Placement of dredged material began in 1985, and the cell currently contains 214,000 cu m of sediment. The capacity of Cell No. 3 has been estimated as 2,200,000 cu m. No material has been placed in this cell yet, and its lakeside entrance is currently closed. (See also W89-08555) (Lantz-PTT)
W89-08571

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL-FISCAL YEARS 1983, 1984, AND 1985,
G. A. Dinwiddie, and N. J. Trask.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4009, 1986. 109p, 7 ref.

Descriptors: *Waste disposal, *Geohydrology, *Radioactive wastes, *Research priorities, Uranium, Mine wastes, Disposal sites, Radioisotopes.

Progress on geologic and hydrologic research related to the disposal of radioactive wastes is described according to whether it is related most directly to: (1) high-level and transuranic wastes, (2) low-level wastes, or (3) uranium mill tailings. Included is research applicable to: the identification and geohydrologic characterization of waste disposal sites; investigations of specific sites where wastes have been stored; and studies of regions or environments where waste disposal sites might be logated. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and (or) retention of waste radionuclides. (Author's abstract)
W89-08626

PRELIMINARY EVALUATION OF THE KNOX GROUP IN TENNESSEE FOR RECEIVING INJECTED WASTES,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08669

PRELIMINARY EVALUATION OF THE BASAL SANDSTONE IN TENNESSEE FOR RECEIVING INJECTED WASTES,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08690

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-6A, H-6B, AND H-6C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08762

PRELIMINARY HYDROLOGIC DATA FOR WELLS TESTED IN NASH DRAW, NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08985

HYDROLOGIC-HYDROCHEMICAL CHARACTERIZATION OF TEXAS GULF COAST SALINE FORMATIONS USED FOR DEEP-WELL INJECTION OF CHEMICAL WASTES,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W89-09012

POTENTIAL IMPACTS OF DISCHARGING TERTIARY-TREATED WASTEWATER INTO PORT ROYAL SOUND, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
G. K. Speiran, and D. L. Belval.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4326, 1985. 33p, 17 fig, 1 tab, 13 ref.

Descriptors: *Tracers, *Path of pollutants, *Wastewater outfall, *Wastewater disposal, *Port Royal Sound, *Environmental effects, *South Carolina, Vertical flow, Flow velocity, Biochemical oxygen demand, Suspended solids.

An assessment of physical characteristics of Port Royal Sound was combined with the results of a dye tracer study and with data collected from a previous environmental study to describe the impact on the water quality from discharging tertiary treated wastewater into the sound. Calculated velocities for the time of maximum velocity in the tidal cycle ranged from 2.32 ft/sec near the bottom to 4.65 ft/sec near the surface of the sound in a cross section in the vicinity of a proposed wastewater outfall. Vertical velocity distributions calculated for the time of maximum velocity were similar at all stations at which velocities were measured except the station in shallow water near the shore. A recent bathymetric chart of the vicinity of the proposed outfall indicates that a bar extends farther along the northern shore of Hilton Head Island than indicated on earlier nautical charts of Port Royal Sound. Continued extension of this bar could alter the impact on water quality from discharge of treated wastewater into the sound. Further study may be needed to monitor

changes in the bar if the outfall is located between the bar and Hilton Head Island. Conservative calculations based on the results of the dye tracer study indicate that the discharge of 10.9 million gallons/day of wastewater having concentrations of biochemical oxygen demand and suspended solids of 15 mg/L will result in a maximum cumulative increase in concentrations of biochemical oxygen demand of < 0.01 mg/L and no increase in concentrations of suspended solids at high slack tide in the part of Port Royal Sound most affected by the proposed wastewater discharge. (Author's abstract)
W89-09030

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: UPDATED REVIEW OF SELECTED PROVISIONS OF STATE SOLID WASTE REGULATIONS,
NUS Corp., Rockville, MD.
R. Nace, M. A. Jennison, M. M. Richardson, Z. Kosim, and A. Geswein.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242458. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/530-SW-88-039, July 1988. 67p, 1 tab, append. EPA contract 68-01-7310.

Descriptors: *Hazardous waste disposal, *Waste disposal, *Regulations, *Municipal wastes, *Leachates, Landfills, Groundwater pollution, Monitoring, State jurisdiction, Federal jurisdiction.

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) directed EPA to revise the 'Criteria for Classification of Solid Waste Disposal Facilities and Practices' (40 CFR Part 257) for facilities that may receive household hazardous waste (HHW) or hazardous waste from small quantity generators (SQGs). Three aspects of the criteria have been compared to State regulations to determine whether the States have standards addressing these areas; whether the State requirements are equivalent to the criteria; or whether the State has the regulatory ground work that would allow the implementation or development of requirements similar to the criteria. The three aspects of the criteria analyzed include requirements for: facility design (i.e., liners, leachate collection systems (LCSs), and final cover); groundwater monitoring; and corrective action. The analysis determined that the majority of the States and territories have established either through regulation or guidance, municipal solid waste landfill requirements for facility design, groundwater monitoring and corrective action that would provide a basic ground work for the implementation or development of requirements equivalent to the revised criteria. It can be assumed, therefore, that these State solid waste programs will not be severely impacted by the revised criteria. (Lantz-PTT)
W89-09050

DESCRIPTION OF THE HAZARDOUS-WASTE RESEARCH SITE,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09053

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT:CASE STUDIES ON GROUNDWATER AND SURFACE WATER CONTAMINATION FROM MUNICIPAL SOLID WASTE LANDFILLS,
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5G.
W89-09063

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: LOCATION RESTRICTIONS (SUBPART B),
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5G.
W89-09064

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: DESIGN CRITERIA (SUBPART D),
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5G.
W89-09066

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: OPERATING CRITERIA (SUBPART C),
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5G.
W89-09067

GEOHYDROLOGIC DATA FOR TEST WELL USW H-5, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09081

CHEMICAL COMPOSITION OF GROUND WATER AND THE LOCATIONS OF PERMEABLE ZONES IN THE YUCCA MOUNTAIN AREA, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09082

OCCURRENCE OF URANIUM IN GROUND WATER IN THE VICINITY OF THE U.S. DEPARTMENT OF ENERGY FEED MATERIALS PRODUCTION CENTER, FERNALD, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09086

GEOHYDROLOGY OF THE UNSATURATED ZONE AT THE BURIAL SITE FOR LOW-LEVEL RADIOACTIVE WASTE NEAR BEATTY, NYE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09088

PRELIMINARY EVALUATION OF THE GEOHYDROLOGY AND WATER QUALITY OF THE GREENACRES LANDFILL AREA, SPOKANE COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09098

WATER-TABLE DECLINE IN THE SOUTH-CENTRAL GREAT BASIN DURING THE QUATERNARY PERIOD: IMPLICATIONS FOR TOXIC-WASTE DISPOSAL,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09107

GEOHYDROLOGY OF AND POTENTIAL FOR FLUID DISPOSAL IN THE ARBUCKLE AQUIFER IN KANSAS, WITH A SECTION ON LOG ANALYSIS OF THE ARBUCKLE AQUIFER,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09122

REVIEW OF TECHNICAL DOCUMENTS: SUPPORTING PROPOSED REVISIONS TO EPA REGULATIONS FOR THE DISPOSAL/REUSE OF SEWAGE SLUDGE UNDER SECTION 405(D) OF THE CLEAN WATER ACT.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
For primary bibliographic entry see Field 5G.
W89-09127

WATER MOVEMENT IN THE UNSATURATED ZONE AT A LOW-LEVEL RADIOACTIVE-WASTE BURIAL SITE NEAR BARNWELL, SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2G.
W89-09230

TEST WELLS TW1, TW2, AND TW3, WHITE SANDS MISSILE RANGE, OTERO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09231

WATER-LEVEL DATA FROM WELLS IN THE VICINITY OF THE WASTE ISOLATION PILOT PLANT, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09241

5F. Water Treatment and Quality Alteration

COMPARISON OF TWO METHODS FOR THE DETECTION OF FECAL POLLUTION IN DRINKING WATER,
Texas Univ., Houston. School of Public Health.
Y. A. Abu-Safieh.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8617351. Ph.D. Dissertation, 1986. 78p, 2 fig, 9 tab, 50 ref.

Descriptors: *Drinking water, *Water analysis, *Feces, *Surface water, *Bacterial analysis, *Coliforms, Potable water, Hydrogen sulfide, Microbiological studies, Water pollution control, Water quality control.

A modified method for detecting fecal pollution in drinking and raw surface water was compared with the standard most-probable-number (S-MPN) technique. No significant difference between the modified test and the multiple-tube fermentation method was observed in detecting fecal pollution in drinking water. The modified test gave more positive results than the multiple-tube fermentation method during the testing of raw surface water. Findings indicate that hydrogen sulfide producing bacteria can survive for the same period of time as the coliform bacteria in fecally contaminated drinking water. The number of hydrogen sulfide producing bacteria is not significantly different from the number of coliforms in the fecally contaminated drinking water. The results suggest that the modified test can be relied upon for testing the microbiological quality of drinking water and raw surface water. (Cremmins-AEPCO)
W89-08248

ADSORPTION FROM SOLUTION BY NOVEL ACTIVATED CARBON: THE RELATIONSHIP BETWEEN PHYSIO-CHEMICAL STRUCTURE AND CHLOROFORM ADSORPTIVE PROPERTIES,
Pennsylvania State Univ., University Park. Dept.

of Materials Science and Engineering.
M. B. Rao.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8606375. Ph.D. Dissertation, 1985. 207p, 53 fig, 26 tab, 64 ref, 5 append.

Descriptors: *Chloroform, *Adsorption, *Water treatment, *Activated carbon, Porosity, Physiochemical properties, Carbon dioxide, Water vapor, Separation techniques.

Porous carbon was prepared for the removal of chloroform from water and to optimize the aqueous chloroform adsorptive properties. The precursor carbon was obtained by pyrolyzing a porous phenol and formaldehyde polymer to 1273 K and holding it for 1 hour. This carbon was activated in C02 at 1123 K for various times and in air at 648 K for 3 hours to open the pore structure. Activation in C02 opened the pore structure without affecting the surface polarity. Whereas activation in air added polar oxygen groups to the surface. The precursor carbon was also treated in boiling HN03 for 5 hours to add a large amount of oxygen to the surface. Samples of the air-activated and HN03-treated carbons were heat treated in N2 and H2 to remove oxygen complexes. The equilibrium adsorptive properties and adsorption kinetics of these carbons were compared to Ambersorb XE-348F activated carbon. The experimental approach can also be used to obtain information on the preparation and characteristics of porous carbons for other solute and solvent systems. (Cremmins-AEPCO)
W89-08251

WATER RESOURCES AND PROVISION PROBLEMS OF RIYADH, SAUDI ARABIA: AN ANALYTICAL STUDY,
Oregon Univ., Eugene. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W89-08263

DEVELOPMENT OF METHODOLOGIES FOR DETERMINING HYDROPOWER WATER STORAGE STRATEGIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. Supangat.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8607687. Ph.D. Dissertation, 1985. 319p, 32 fig, 21 tab, 45 ref, 5 append.

Descriptors: *Computer models, *Water storage, *Model studies, *Water resources development, *Hydroelectric power, *Reservoir operation, Water supply, River basin development, Data processing, Optimization, Simulation analysis, Reservoir storage.

Three computer models were developed for use by water resources planners and managers to evaluate water storage strategies for water supply or hydropower of a river basin. A data preparation model, DATASN, is used to create a data file for the screening procedure. A simulation model, WATPOW, is built into DATASN to determine the relationships of reservoir annual firm yield or energy versus storage construction for potential sites in the basin. A screening model is used to determine the optimal system configurations of a river basin for water or energy based on minimizing the total reservoir construction costs. This SCREENS model uses a dynamic programming technique and the Hall decomposition procedure to perform the optimization procedure. A simulation model was developed to refine the hydropower configurations obtained by the optimization procedure. This model, SIMSCRN, simulates each reservoir at a time starting from the most upstream reservoir. An independent operating rule is implicitly built into the model as if the reservoir were a single system. This rule matches the assumption made during the screening process. The methodology was applied to the CE-646 Class Problem and the Yampa River Basin in Colorado as case studies. (Cremmins-AEPCO)
W89-08266

OZONE H20 TREATMENT,
E. J. O'Brien.
U.S. Patent No. 4,619,763; October 28, 1986, 7p, 5 fig. Official Gazette of the United States Patent Office, Vol 1071, No 4, p1678, October 28, 1986.

Descriptors: *Patents, *Ozonation, *Water treatment, *Potable water, Injection, Cooling, Ozone, Water treatment facilities, Venturi meters, Disinfection.

A water purification system compromises a source of water under pressure and an ozone generator. The generator enriches the concentration of ozone in the atmosphere to be passed through the incoming water to a level between about 1% and 3%. Ozone-enriched atmosphere is chilled as it passes from the generator to the injection site. Dry air or dry oxygen is used in the passage through the ozone generator to further preserve the quality of the ozone. The dry gas has a dewpoint preferably in the range of below about minus 60 F. A venturi injector provides a constant and consistent source of an ozone-enriched atmosphere. Water recirculates from a reservoir or holding tank for at least partial repeated passages through the venturi injector to achieve repeated exposure of the water to ozone. (Cremmins-AEPCO)
W89-08272

OZONE DRINKING WATER PURIFICATION APPARATUS,
R. Gesslauer.
U.S. Patent No. 4,599,166; July 8, 1986, 7p, 3 fig. Official Gazette of the United States Patent Office, Vol 1068, No 2, p739, July 8, 1986.

Descriptors: *Patents, *Ozonation, *Water treatment, *Drinking water, Oxidation-reduction potential, Ozone, Injection, Cooling water, Refrigeration, Domestic water, Disinfection.

An ozone drinking water cooling and purification apparatus compromises a supply system, a cooler, a monitor of the redox potential, an ozone generator, and an ozone injector. The supply system includes a tank for water storage. The ozone injector increases the redox potential whenever a measuring device signals that the potential is below the preselected one. A control device prevents water not having at least the preselected drinking water redox potential from being drawn from the faucet. (Cremmins-AEPCO)
W89-08273

WATER PURIFICATION AND STERILIZATION SYSTEM,
Mortenson (J.) and Co. Ltd., Kowloon (Hong Kong).
J. G. Mortensen.
U.S. Patent No. 4,615,799; October 7, 1986, 5p, 5 fig. Official Gazette of the United States Patent Office, Vol 1071, No 1, p 269-270, October 7, 1986.

Descriptors: *Patents, *Water treatment, *Disinfection, *Sterilization, *Potable water, *Ultraviolet radiation, *Filtration, Domestic water, Activated carbon.

Potable water is purified using filtration and ultraviolet sterilization. A pressurized water system contains a filter canister and an ultraviolet irradiation chamber for receiving water expelled from the canister. A conduit fluidly connects the filter canister and the ultraviolet irradiation chamber. The received water is exposed to a level of ultraviolet radiation sufficient to kill essentially all living organisms within the water prior to its expulsion from the chamber. The annular-shaped irradiation chamber consists of outer and inner cylindrical walls, a tubular source of ultraviolet radiation, a water inlet and an outlet, and a system for sealing the ends of the chamber. A solenoid-activated shut-off valve cuts off the water flow from the purifier whenever a control circuit detects a failure of the lamp or a loss of the line power. Unlike distillation system, the filtering and sterilization process of this purifier does not remove essential minerals from the water. (Cremmins-AEPCO)
W89-08274

WATER PURIFICATION SYSTEM,
Nimbus Water Systems, Inc., Escondido, CA.
D. T. Bray.
U.S. Patent No. 4,711,723; December 8, 1987, 5p, 2 fig. Official Gazette of the United States Patent Office, Vol 1087, No 2, p830, December 8, 1987.

Descriptors: *Patents, *Water treatment, *Drinking water, *Municipal water, Reverse osmosis, Activated carbon, Separation techniques, Semipermeable membranes, Membrane filters.

A self-contained water purification device contains an integral, free-standing housing including a base for supporting the device. The device comprises a pressure vessel supported in the housing and a first tubing system for receiving supply water at a pressure between 20 and 100 psig. A reverse osmosis filter element contains a semipermeable membrane with a surface area of at least 2 sq cm/cu cm of volume of the reverse osmosis filter element. A portion of the supply water and impurities unable to pass through the reverse osmosis filter element are discharged from the pressure vessel. A second tubing system receives product water that has passed through the filter element. This tubing exists from the pressure vessel and terminates at an inlet to a carbon unit within the base, which contains between 10 and 1,000 grams of activated carbon. The product water has a residence time within the carbon of between 5 and 30 minutes. A flow passage within the base causes the product water to flow through the activated carbon and a third tubing system receives the product water and terminates in a region exterior to the housing. (Cremmins-AEPCO)
W89-08277

SYSTEM FOR THE ONE-STEP DEWATERING OF A TRENCH AND THE CONSTRUCTION OF A PIPELINE BED,
For primary bibliographic entry see Field 8A.
W89-08278

WATER PURIFICATION PROCESS,
Sale (G.S.), Bryan, TX.
G.S. Sale.
U.S. Patent No. 4,724,079; February 9, 1988, 5p, 2 fig. Official Gazette of the United States Patent Office, Vol 1087, No 2, p 720-721, February 9, 1988.

Descriptors: *Patents, *Water treatment, *Chlorination, *Groundwater, *Municipal water, Ion exchange, Adsorption, Filtration, Ultrafiltration, Reverse osmosis, Particulate matter, Sterilization, Sodium, Water storage.

Undesirable components are removed from groundwater or municipal water and low-sodium, low-particulate, sterile water is produced that is suitable for the manufacture of food and beverages. The water is passed through an ion exchanger to remove hard water cations and through a filter to remove chlorine. The water is then passed through a second filter to remove particulates greater than about 20 microns in diameter. The water is next passed through an ultrafiltration system and subjected to reverse osmosis. Chlorine is added to the water in an effective amount to supress microbes. The added chlorine is removed by passing the water through sterile carbon particles. The particles are contained in a receptacle of at least one sterile, autoclavable tank. Generally, the method uses ion exchange, adsorption, filtration by particulate size, ultrafiltration, and reverse osmosis in combination with a closed holding system requiring only 2-3 ppm chlorine for sterilization. (Cremmins-AEPCO)
W89-08284

APPARATUS FOR MICROAQUACULTURE AND POLLUTION CONTROL,
C. D. Van Ry.
U.S. Patent No. 4,690,756; September 1, 1987, 10p, 8 fig, 1 tab, 6 ref. Official Gazette of the United States Patent Office, Vol 1082, No 1, p 338, September 1, 1987.

Descriptors: *Patents, *Water treatment, *Separation techniques, *Seawater, Bubbles, Foaming, Baffles, Tubes, Air circulation, Compressed air, Water pollution prevention.

Dissolved and particulate matter are produced and removed from sea water in situ at any desired location without the need to transport the water to a land-based apparatus. A hollow tube contains an open top and bottom, which is covered with a screen. The tube is supported vertically in a body of water so that the top is disposed proximate to the surface. An air releasing system is connected to a source of compressed air and is placed near the open bottom of the tube so that air released will form bubbles that rise within the tube and draw in water through the open bottom. Water upwelling in the tube lifts a baffle and overflows the top of the tube. The baffle is shaped to direct foam provided by the bubbles to at least one opening. A reservoir around the baffle or receiving foam passes through the baffle and an outlet removes the foam from the reservoir. (Cremmins-AEPCO)
W89-08286

MAINTENANCE OF CISTERN WATER QUALITY AND QUANTITY IN THE VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
For primary bibliographic entry see Field 5A.
W89-08336

INVESTIGATION OF NOVEL ADSORPTIVE SEPARATION METHODS FOR REMOVAL OF TRACE HEAVY METALS FROM POLLUTED AREAS,
Idaho Univ., Moscow. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-08339

LABORATORY PLANNING FOR WATER AND WASTEWATER ANALYSIS,
Laboratory Consultants, Albuquerque, NM.
For primary bibliographic entry see Field 5D.
W89-08369

INVENTORY OF INTERBASIN WATER TRANSFERS IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08377

TREATMENT OF WATER SUPPLIES CONTAMINATED WITH TOXIC POLLUTANTS USING TAILORED SOILS,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 5G.
W89-08438

REVERSE OSMOSIS FOR REMOVING SYNTHETIC ORGANICS FROM DRINKING WATER: A COST AND PERFORMANCE EVALUATION,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
B. W. Lykins, R. M. Clark, and C. A. Fronk.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-225016. Report No. EPA/600/D-88/134, June 1988. 25p, 12 fig, 6 tab, 9 ref.

Descriptors: *Cost analysis, *Drinking water, *Reverse osmosis, *Organic compounds, *Water treatment, Costs, Economic aspects, Activated carbon, Inorganic compounds, Waste disposal, Membrane processes, Performance evaluation.

According to the Safe Drinking Water Act Amendments, granular activated carbon was specified as being feasible for control of synthetic organic chemicals (SOCs). Therefore, any treatment technique for SOCs must be as effective as granular activated carbon. One such treatment technique may be reverse osmosis. Until recently, reverse osmosis was mainly evaluated for removal of salts and other inorganic compounds but both bench-scale and field studies have shown its effectiveness for removing SOCs from drinking water. Using standardized cost curves, the cost of reverse osmosis for various scenarios was calculated. One of the main concerns and reservations of using reverse osmosis is concentrate disposal. If reverse osmosis is selected by a community, utility, or individual home owner as the best treatment for their situation, performance will be one selection criterion. Another consideration will be cost compared to other available treatment options. (Author's abstract)
W89-08484

FLOW SEPARATION CONDITIONS AT PIPE WALLS OF WATER DISTRIBUTION MAINS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 8B.
W89-08485

COMPARISON OF TRACE LEVEL CONCENTRATIONS FOR SILVER, ARSENIC, BARIUM, CADMIUM, AND LEAD IN DRINKING WATERS OBTAINED BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY AND ELECTROTHERMAL-VAPORIZATION ATOMIC ABSORPTION SPECTROSCOPY,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5A.
W89-08496

RENEWABLE ENERGY SOURCES AND VILLAGE WATER SUPPLY IN THE DEVELOPING COUNTRIES.
Commission of the European Communities, Luxembourg.
Available from the National Technical Information Service, Springfield, VA 22161 as EUR 10507, price codes: E04 in paper copy, E04 in microfiche. March 1985. 79p, 5 append.

Descriptors: *Developing countries, *Water resources development, *Water resources management, Rural areas, Energy, Economic aspects, Mali, Case studies, Solar energy, Wind.

Village water supply is one of the leading rural development priorities in developing countries. In order to achieve the goal set for village water supply programs-providing adequate quantities of drinking water-it is necessary to choose an appropriate method for water lifting from among the many types of equipment available, including manual, mechanized, and motorized systems. Available sources of renewable energy, essentially wind and solar energy, can be applied in the same way as human or animal power, or even diesel systems. The question, therefore, is whether to give preference to: (a) methods that are low in capital investment and provide relatively poor performance, (b) those that require considerable capital investment and complex maintenance but provide high performance, or (c) those methods that require a moderate capital investment but whose operating costs are high. This report is not intended to offer definitive answers to this question, but rather to provide assistance to decision makers-program sponsors and development program directors-who are not experts in water supply. It shows that renewable energy systems (such as wind pumps, solar pumps, and wind turbine generator pumps) can be valuable components of village water supply systems, and that their inclusion is justifiable under specific circumstances. It also demonstrates the importance of both quality of service and economic considerations as selection criteria and offers the specific application of methodology used in Mali by the Mali Aqua Viva program as an illustration. (Lantz-PTT)
W89-08498

TROUBLESHOOTING AN EXISTING TREATMENT PLANT,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
G. S. Logsdon, L. Mason, and J. B. Stanley.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-218441. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/126, June 1988. 17p, 3 fig, 3 tab, 9 ref.

Descriptors: *Water treatment facilities, *Water treatment, *Population expsosure, *Performance evaluation, Turbidity, Filtration, Water quality control, Costs, Physical treatment, Water management, Human diseases, Case studies.

Investigating a filtration plant that is not meeting the performance criteria for turbidity or is having a problem of performance may become a more common activity if the Surface Water Treatment Rule is enacted as proposed, with the operating criteria of producing water with a turbidity of 0.5 Nephelometric Turbidity Units (NTU) or lower in at least 95% of the samples measured each month, for plants that coagulate and filter water. This paper reviews the procedures used during the investigation of the Carrollton Water Filtration Plant in February 1987, at the time of a waterborne outbreak caused by Cryptosporidium. Recommendations for improvements in equipment and operating procedures are given, and the changes made are described. Information is presented on present water quality vs. quality before the outbreak. Improvements to the 9 MGD plant have cost about $300,000. (Lantz-PTT)
W89-08521

REVERSE OSMOSIS TREATMENT TO REMOVE INORGANIC CONTAMINANTS FROM DRINKING WATER,
Charlotte Harbor Water Association, Inc., Harbour Heights, FL.
M. R. Huxstep, and T. J. Sorg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-147780. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-87/109, December 1987. 50p, 12 fig, 24 tab, 10 ref. EPA Contract CR-807358.

Descriptors: *Pollutants, *Water treatment, *Drinking water, *Reverse osmosis, *Inorganic compounds, Membranes, Hardness, Dissolved solids, Fluoride, Cadmium, Mercury, Chromium, Arsenic, Selenium, Nitrates, Nitrites, Lead, Uranium, Radium, Molybdenum, Copper, Performance evaluation, Material testing.

Inorganic contaminants were removed from drinking water using several 'state-of-the-art' reverse osmosis membrane elements. A small 3785 L/d (1000 gpd) reverse osmosis system was utilized and five different membrane elements (Toray SC 3100, Filmtec BW30-4021, Dow low pressure 5K, Dupont B-9 Model 0440-042, and Hydranautics P/N 4040 LSY-1FC1) were studied individually with the specific inorganic contaminants added to several natural Florida groundwaters. Testing of each contaminant was conducted for a period of 1-13 days during which both operational and chemical data were collected. Results of the tests for the removal capabilities of various reverse osmosis membrane elements for the following inorganic contaminants: fluoride, cadmium, mercury, chromium (III and VI), arsenic (III and V), selenium (IV and VI), nitrate, nitrite, lead, uranium, radium, molybdenum and copper, are presented. Removal data were also collected on naturally occurring substances, i.e. total hardness, chlorides, total dissolved solids and in some cases sodium and calcium. All of the membranes averaged > 95% removal of total dissolved solids (TDS) with some averaging 98%. One membrane (Filmtec) showed a noticeable decline in TDS rejection during the first 40 days of test run from around 98% to 85%. After the 40th day, TDS rejection returned to the initial level of about 97-98% and remained constant for the last 30 plus days. All of the membranes removed > 98% of total hardness and 93-95% of the chloride. Data from the last two series of tests for the Dupont and Hydranautics membranes showed average removal of around 98% for calcium and 96% for sodium. Because calcium is the primary constituent of total hardness, calcium re-

moval results are similar to those for hardness removal. (Lantz-PTT)
W89-08528

MICROBIOLOGY AND DRINKING WATER FILTRATION,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
G. S. Logsdon.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-225057. Price codes: A04 in paper copy, A01 in microfiche. Report No. EOA/600/D-88/139, June 1988. 58p, 1 fig, 3 tab, 53 ref.

Descriptors: *Microbiological studies, *Drinking water, *Filtration, *Water treatment, Bacteria, Viruses, Protozoa, Sand filters, Pilot plants, Physical treatment.

This paper briefly reviews historical filtration research for control of bacteria. It provides a comprehensive review of modern research for removal of bacteria, viruses, and protozoan cysts. Processes discussed are slow sand filtration, diatomaceous earth filtration, and the variations of coagulation-filtration (rapid sand filtration, direct filtration, and in-line filtration). Pilot plant data were emphasized, but when possible the results of full scale filter plants are also presented. All of the treatment processes reviewed in this chapter can remove viruses, bacteria, and Giardia cysts from raw water with proper facility design, necessary maintenance, and appropriate operational procedures. Filtration plant performance can be evaluated by a number of methods including turbidity, particle count by electronic instrument, total microscopic count of bacteria, microscopic analysis of particulate count from wound filters, and analysis for viruses, bacteria, or protozoan cysts. When culture techniques are used to evaluate microorganism removal in filtration, disinfection must not be practiced before filtered water samples are collected; otherwise the actual degree of physical removal can not be determined. Simultaneous use of more than one evaluation technique may be appropriate, not only for research but also for plant operation. (Lantz-PTT)
W89-08551

REMOVAL OF VOLATILE ORGANIC CHEMICALS FROM POTABLE WATER: TECHNOLOGIES AND COSTS.
Environmental Science and Engineering, Inc., Gainesville, FL.
Noyes Data Corporation, Park Ridge, New Jersey. 1986. 231p.

Descriptors: *Costs, *Volatile organic compounds, *Potable water, *Water treatment, Aeration, Organic compounds, Air stripping, Granular activated carbon, Adsorption, Powdered activated carbon, Activated carbon, Water quality control, Ozonation, Ultraviolet radiation.

The information provided in this document is intended to aid in selecting the best treatment method for providing a water free from or with acceptable concentrations of volatile organic compounds (VOCs). It provides the user with an evaluation of the various treatment methods in use today for the removal of different concentrations of VOCs and several nontreatment alternatives, as well as relative costs. The methods that can be applied are divided into three general categories: most effective treatment technologies--technologies that are generally available, have a demonstrated highly effective capacity to remove VOCs, and for which reasonable cost estimates can be developed for a wide range of influent/effluent conditions; other treatment/alternative technologies--nontreatment or compliance measures, such as new sources or regionalization, or technologies which are less efficient or may not be applicable to all plants; and additional technologies--technologies which experimentally have been shown to have potential for removing VOCs, but for which insufficient data exist to fully evaluate the technology. For waters contaminated with VOCs, the following treatment technologies are designated as the Most Effective Technologies for all of the system size categories: (1) Packed tower aeration, and (2) granular activated carbon adsorption. Methods which have been designated as Other Treatment/Alternative Technologies: multiple-tray aeration, diffused aeration, spray aeration, air-lift pumping, cascade aeration, mechanical aeration, powdered activated carbon adsorption, well field management, bottled water, regionalization, and alternate sources. Additional treatment technologies include the following: (1) point-of-use and point-of-entry devices, home carbon adsorption units, distillation units; (2) point-of-use and point-of-entry devices, home reverse osmosis units; and (3) ozone plus ultraviolet radiation. (Lantz-PTT)
W89-08699

SMALL WATER SYSTEM TREATMENT COSTS,
Culp/Wesner/Culp, Santa Ana, CA.
R. C. Gumerman, B. E. Burris, and S. P. Hansen.
Noyes Data Corporation, Park Ridge, New Jersey. 1986. 568p.

Descriptors: *Costs, *Water treatment, *Water treatment facilities, Management planning, Maintenance, Construction costs, Computer programs, Sludge, Brine, Filtration, Membrane processes, Adsorption, Ion exchange, Aeration, Chemical treatment.

This book presents construction, operation and maintenance cost data for centralized treatment techniques and point-of-use treatment techniques. The cost data are based on December 1983, data. Treatment techniques included were selected for their ability to remove contaminants included in the National Interim Primary Drinking Water Regulations. The majority of these unit processes are 'package' systems which are factory prefabricated and shipped to the required locations. Other processes included are chemical feed systems and sludge and brine handling techniques. Costs are also included for five different point-of-use treatment techniques. Point-of-use treatment is used at individual homes, rather than in a central location. Point-of-use treatment may be applicable in very small systems where centralized treatment is not feasible or economical. A computer program and manual are included for retrieval and updating of cost data presented in this book. The 45 centralized treatment techniques which are included, are divided into 8 broad technique categories: (1) complete treatment techniques, (2) filtration techniques, (3) ion exchange and adsorption techniques, (4) aeration, (5) chemical feed systems, (6) sludge and brine handling techniques, (7) miscellaneous techniques, (8) membrane treatment techniques. (Lantz-PTT)
W89-08700

CONTROL OF ORGANIC SUBSTANCES IN WATER AND WASTEWATER.
For primary bibliographic entry see Field 5D.
W89-08701

FUNDAMENTAL CONSIDERATIONS IN THE REMOVAL OF ORGANIC SUBSTANCES FROM WATER-A GENERAL OVERVIEW,
Louis Koenig-Research, San Antonio, TX.
For primary bibliographic entry see Field 5D.
W89-08702

COAGULATION-SEDIMENTATION-FILTRATION PROCESSES FOR REMOVING ORGANIC SUBSTANCES FROM DRINKING WATER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. K. Edzwald.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 26-64, 18 fig, 5 tab, 61 ref.

Descriptors: *Water treatment, *Coagulation, *Sedimentation, *Filtration, *Drinking water, *Trihalomethanes, *Organic compounds, Chlorination, Water treatment facilities, Pocess control.

Trihalomethanes (THMs) are produced within the water treatment system as by-products of chlorination. A wide variety of organics, including dissolved, colloidal, and particulate forms, act as THM precursors. The following are discussed: (1) to describe the formation of trihalomethanes; (2) to describe the principles pertaining to separation of particles by coagulation, sedimentation, and filtration; (3) to summarize current knowledge of concepts regarding organics removal by coagulation and filtration; (4) to illustrate the performance of actual water treatment plants in removing THM precursors and reducing THMs; and (5) to discuss possible water treatment process control parameters and THM surrogate measurements. (Lantz-PTT)
W89-08703

ADSORPTION OF ORGANIC SUBSTANCES IN DRINKING WATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
F. A. DiGiano.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 65-118, 34 fig, 10 tab, 110 ref.

Descriptors: *Water treatment, *Adsorption, *Organic compounds, *Drinking water, Trihalomethane, Activated carbon, Organic matter, Microbial degradation, Resins.

Throughout the modern history of water treatment, adsorption has been used for removal of taste and odor causing compounds. Compounds associated with taste and odor derive from chlorinated phenols and by-products of algal and vegetable matter decay. In the case of chlorinated phenols, their precursor, phenol, may be adsorbed prior to chlorination. Adsorption has also found application following chlorination for removal of chlorinated aromatic compounds and excess free or combined chlorine which may be present. The adsorbent of choice has traditionally been powdered activated carbon (PAC). This is so because it does not require significant capital investment and because it is used only when taste and odor problems arise, e.g. seasonally. Although the historical function of PAC as an adsorbent of taste and odor compounds remains important today, the early 1960's brought recognition of the more general role of adsorption in removing organic contaminants, and the 1970's brought about the formation of survey groups from Environmental Protection Agency to establish the organic contaminants contained in drinking water, and the Safe Drinking Water Act of 1974. The following are discussed: the principles of adsorption; process development with respect to trihalomethanes and humic substances, competition for adsorption sites, adsorption on synthetic resins, regeneration of adsorbents, microbial activity on activated carbon, and influence of pretreatment; and current, state-of-the-art technologies. (Lantz-PTT)
W89-08704

REMOVAL OF ORGANIC SUBSTANCES FROM WATER BY AIR STRIPPING,
Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 119-147, 12 fig, 6 tab, 27 ref.

Descriptors: *Water treatment, *Air stripping, *Organic compounds, Henry's Law, Chemical properties, Ammonia, Mass transfer, Costs, Trihalomethanes, Groundwater pollution.

Air-stripping has good potential as an economical water treatment process. It has a long history of usage in the water treatment field for removal of inorganic gases and some taste and odor producing compounds, and has direct relevance to the organic problems of concern today. It has potential for direct treatment of surface waters that may contain many different volatile organic chemicals, for disinfected waters containing high concentrations of trihalomethanes, and for contaminated groundwaters that in a growing number of cases contain volatile organic chemicals in relatively high concentration. Many different methods are available

for stripping volatile organic materials from water, but in general they rely upon the same physical principles. The three major factors that affect the efficiency of removal by a given process are the air to water ratio, the detention time, and the rate of mass transfer. In a stripping tower the actual detention time of the water is not readily measured, but is a function of the tower height which is generally the design variable used. Mass transfer may be either liquid-phase controlled for compounds with Henry's law constants well above 0.07, or gas-phase controlled when values are well below this. When removals are liquid-phase controlled, then mass transfer coefficients determined with oxygen can be used for design after appropriate correction for differences in diffusivity are made. When removals are gas-phase controlled, then transfer coefficients for other material such as ammonia can be used. The mass transfer coefficient for a given system is a function of many factors, but in general the greater the turbulence of the controlling phase and the greater the exposed air-water surface, the higher the rate of transfer. The most appropriate system for a given situation depends upon economics plus a variety of other considerations previously mentioned. Perhaps the major trade-off is between construction cost and power costs. (See also W89-08701) (Lantz-PTT)
W89-08705

OXIDATION OF ORGANIC SUBSTANCES IN DRINKING WATER,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
W. H. Glaze.
IN: Control of Organic Substances in Water and Wastewater. Noyes Data Corporation, Park Ridge, New Jersey. 1987. p 148-174, 9 fig, 8 tab, 113 ref.

Descriptors: *Oxidation, *Water treatment, *Drinking water, *Organic compounds, Chlorination, Ozonation, Chlorine dioxide, Chlorine, Ozone, Permanganate, Hydrogen peroxide, Catalysis, Chemical reactions, Costs.

Although oxidation processes occur to some extent in virtually all drinking water treatment plants, oxidation per se has not been viewed traditionally as an important unit process. This situation most surely will change in the coming decade as more stringent standards for drinking water quality are prescribed. In particular, oxidation processes offer one of the few means for the removal of potentially toxic organic substances such as pesticides, industrial solvents, and other synthetic organic chemicals. These substances generally are not removed by traditional water treatment processes, and to the extent that their presence is a source of concern, oxidation processes may develop into important treatment alternatives. Three oxidation processes are emphasized in this chapter: chlorine (in its various aqueous forms), ozone, and chlorine dioxide. In addition, other oxidants such as permanganate, hydrogen peroxide and catalytic systems such as ozone with ultraviolet radiation are discussed. In most cases, the oxidation process is discussed in terms of its basic chemistry, studies which reveal its relative efficacy for organic compounds removal, and the expected costs of applying the process to water treatment. Evidence concerning by-product formation also presented. (See also W89-08701) (Lantz-PTT)
W89-08706

WATER RESOURCES OF MALDIVES,
Ministry of Agriculture, Male (Maldives).
For primary bibliographic entry see Field 3B.
W89-08905

METAL PIPING AND JOINING MATERIALS AND FITTINGS,
Copper Development Association, Inc., Greenwich, CT.
P. A. Anderson.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 2-9, 2 fig.

Descriptors: *Drinking water, *Plumbing, *Copper, *Pipelines, *Water quality, Conveyance structures, Lead, Corrosion.

Copper tube and fittings have been the dominant accepted plumbing products in the United States for several decades, providing trouble-free service to residential and commercial users. Although corrosion has occurred in copper plumbing systems, studies show this situation to be highly localized and preventable. Other than for faulty design and poor workmanship, corrosion and metal pickup are invariably associated with aggressive water compositions. Successful treatments utilized by local water utilities have corrected the water chemistry problems. This has resulted in trouble-free plumbing systems for the consumer and high quality drinking water. The same approach can protect consumers from lead pickup from poorly made solder joints in those few, potable water systems that are aggressive as a result of acidity and lack of hardness. (See also W89-08967) (Lantz-PTT)
W89-08968

IMPACT OF LEAD PIPING AND FITTINGS ON DRINKING WATER QUALITY,
Environmental Protection Agency, Boston, MA. Water Supply Branch.
P. C. Karalekas.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 28-37, 4 tab, 10 ref.

Descriptors: *Plumbing, *Water quality control, *Lead, *Drinking water, *Pipes, Corrosion, Water treatment, Regulations, Water quality, Pipelines.

Widespread use of lead service lines and goosenecks has occurred in many water systems, although many systems have less than the optimum treatment for controlling lead corrosion. High lead concentrations in studied communities can be found if water samples are taken in a careful, systematic manner. The Interim Primary Drinking Water Regulations requiring only one sample/yr are inadequate to identify the presence and amount of lead resulting from corrosion. The solution to the problems with lead involve systematic removal of lead materials, and water treatment to reduce corrosion. Although lead services are a major contributor of lead, other sources such as lead/tin solder must also be considered in any overall control strategy. It is recommended that the use of lead as an acceptable material for conveying drinking water be removed from plumbing codes. (See also W89-08967) (Lantz-PTT)
W89-08970

IMPACT OF COPPER, GALVANIZED PIPE, AND FITTINGS ON WATER QUALITY,
Illinois State Water Survey Div., Champaign.
C. H. Neff.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 38-60, 3 fig, 10 tab, 45 ref.

Descriptors: *Plumbing, *Water quality, *Copper, *Pipes, *Drinking water, Zinc, Lead, Pipelines, Steel, Water treatment.

Many studies have shown that copper tubing, galvanized steel pipe, and brass fittings have increased the lead, zinc, iron, and copper concentrations in drinking water. Water quality and water treatment will influence the degree of impact these plumbing materials will have. The maximum contaminant levels (MCLs) for these metals have been exceeded most often in standing samples from household taps. Brass sampling valves may have made a significant contribution to the metal concentrations reported in many studies. Newly installed copper or galvanized steel plumbing may require several months to attain stable, minimum metal values in the drinking water. Stability may never be achieved in some water supplies due to fluctuating water chemistry. Disinfection methods and polyphosphate usage may also increase the solubility of metals from copper or galvanized plumbing. Continued research is required to identify the sources of these metals and to control their solubility in drinking water. Basic information is needed on the nature of protective corrosion films, the influence of complexing agents on the film, and the water chemistry necessary to form the film. (See also W89-08967) (Lantz-PTT)
W89-08971

SUMMARY OF IMPACT OF METALLIC SOLDERS ON WATER QUALITY,
H2M Corp., Melville, NY.
N. E. Murrell.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 61-66, 1 tab.

Descriptors: *Plumbing, *Water quality, *Pipelines, *Lead, *Drinking water, Hydrogen ion concentration, Hardness, Pipes.

An incident of lead poisoning in Smithtown, New York, prompted the consumer's request for testing of his home water supply. Lead solder was suspected as the source of the lead. Every home in the 8-yr old subdivision was tested. The two occupied homes with high first-draw lead levels both had recent plumbing additions using lead solder. A new home under construction had an even higher first-draw lead value of 7,100 micrograms/L. Prior studies in the United States, Canada, and Europe showed high lead values in first-draw water after periods of non-use. The lead values were higher in water systems with low pH and soft water. Leaching of metallic solders, particularly lead solder, appears to be affected by many factors: pH of water, plumbing workmanship, hardness of water, time since last use of water, age of solder, and percentage of lead in solder. (See also W89-08967) (Lantz-PTT)
W89-08972

IMPACT OF LEACHING BY PLASTIC PIPE, FITTINGS, AND JOINING COMPOUNDS,
SRI International, Menlo Park, CA.
T. Podoll.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 68-76, 4 fig, 1 tab, 5 ref.

Descriptors: *Leaching, *Drinking water, *Plumbing, *Plastics, *Pipes, Polybutylene, Chlorinated polyvinyl chloride, Organic compounds.

The California Department of Housing and Community Development (DHCD) is proposing to expand the use of plastic plumbing pipe in residential construction. The principle change with regard to water quality is to allow polybutylene (PB) and chlorinated polyvinyl chloride (CPVC) pipe in hot and cold potable water supply systems inside dwellings. This environmental review provides an overview of existing information about the environmental impact of the new applications of plastic pipe and identifies areas where better information is needed. The impact of leached chemicals can depend on either the instantaneous concentration of the chemicals in the water or the cumulative exposure to varying concentrations over time. Different chemicals would show more or less rapid declines over time after installation, depending on their properties and their initial distribution in the pipe. The general pattern, however, is only a large-scale picture; many events disturb the smooth trend. Concentrations build up when water stands in the pipe for a period of time ('dwell time'), for example, overnight or during a vacation. When the system is flushed, concentrations drop to the background levels of the incoming water supply. CPVC leaching data indicate that: pipe cement solvents (MEK, THF, cyclohexanone, and DMF) are initially leached at very high concentrations, but these concentrations diminish rapidly with repeated flushing; low molecular weight chlorinated organics (dichloromethane, carbon tetrachloride, tetrachloroethene, and trichlorethene) are leached in the low (1-10) parts per billion concentration range during initial dwell periods; and chloroform is a possible leachate. The leachability studies of PB were generally of lower quality than those of CPVC. However, one study indicated the presence of Irganox 1010 derivatives in leachate waters. Irganox 1010 is an antioxidant that is present in PB at $< 0.5\%$. (See also W89-08967) (Lantz-PTT)
W89-08973

NSF STANDARD AND CERTIFICATION PROGRAM FOR PLASTICS PIPE: STANDARD 14,
National Sanitation Foundation, Ann Arbor, MI.
For primary bibliographic entry see Field 8G.
W89-08974

TREATMENT OR WATER QUALITY ADJUSTMENT TO ATTAIN MCLS IN METALLIC POTABLE WATER PLUMBING SYSTEMS,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
M. R. Schock.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 86-106, 6 fig, 3 tab, 41 ref.

Descriptors: *Water treatment, *Plumbing, *Heavy metals, *Pipelines, *Drinking water, Pipes, Copper, Zinc, Cadmium, Lead, Iron, Chemical treatment, Calcium carbonate, Hydrogen ion concentration, Silica, Orthophosphate, Phosphates.

Virtually all of the common household or building plumbing materials-copper tubing, galvanized steel, lead pipe, brass fittings, and tin/lead solder-will oxidize and dissolve to some extent in potable waters. The byproducts of these corrosion reactions can be of concern because of aesthetic or toxicological reasons. Traditionally, corrosion control measures taken by water utilities have been aimed at preventing tuberculation and perforation of cast-iron distribution mains, eliminating 'red water' complaints, and protecting dissolution of cement-mortar-lined or asbestos-cement pipe. The impact of several common treatment approaches on the formation of corrosion by-products from common building plumbing materials was examined. The treatment approaches covered are: calcium carbonate saturation, pH adjustment, pH plus carbonate adjustment, orthophosphate addition, polyphosphate addition, and silicate addition. Case studies and solubility calculations for zinc, copper (II), and lead (II) in drinking water show that several control strategies have proven adequate for the attainment of current maximum contaminant levels and secondary maximum contaminant levels. The most difficult metal to control is lead, and for some water chemistries flushing of the lines before taking water for human consumption may be required if optimization of treatment for lead corrosion control cannot be accomplished. (See also W89-08967) (Lantz-PTT)
W89-08975

DRINKING WATER REGULATIONS AND THEIR IMPACT ON MATERIALS USED IN WATER SYSTEMS,
Oregon State Health Div., Portland. Drinking Water Program.
For primary bibliographic entry see Field 5G.
W89-08976

EUROPEAN DEVELOPMENT IN USE OF PLUMBING MATERIALS,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
I. Wagner.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 113-126, 8 tab, 23 ref.

Descriptors: *Drinking water, *Pipes, *Materials testing, *Water conveyance, *Plumbing, *Plastics, Copper, Lead, Steel, Polyethylene, West Germany, Water quality control, Corrosion, Netherlands, Organic compounds, Great Britain.

The plumbing materials used in Europe during the last century were lead, copper, and galvanized steel. Recently plastic materials, especially cross-linked polyethylene, came on the market for residential drinking water installations. Depending on the distribution method, individual countries made greater or lesser use of different plumbing developments. Changes in the quality and use of plumbing materials were due to changes in price or technical quality (mainly due to corrosion), and health considerations. With these changes, use of lead plumbing in Europe decreased significantly, and the installation of cross-linked polyethylene pipes in a double-tube system with metallic joints became commonplace. Although the cost of plumbing systems in new house installations, mainly in Germany, increased over the last 30 years (with the ratio of galvanized steel to copper pipes changing from 6:1 to 3:2), the use of lead was ruled out because of health problems. Polyethylene pipe was developed mainly to correct local corrosion problems caused by metallic pipe. Recommendations were developed in different European countries in order to guarantee that the quality of nonmetallic materials would have no undesirable health effects. Initial recommendations and test methods covering materials in contact with drinking water were developed (in the Netherlands and the Federal Republic of Germany) to regulate specifically the leaching of lead from lead-stabilized, hard-PVC tubes in contact with drinking water. Later recommendations covered other questions, for example organoleptics, migration of total organic carbon, chlorine and oxygen demand, and microbiological aspects. The emphasis differs from country to country; while in Great Britain the recommendations are based mainly on microbiological aspects, in Germany the recommendations and methods have a more chemical and analytical direction. (See also W89-08967) (Lantz-PTT)
W89-08977

5G. Water Quality Control

TOXICOLOGIC RISK MANAGEMENT AT THE COMMUNITY LEVEL: THE CASE OF CHEMICALLY CONTAMINATED GROUNDWATER USED AS DRINKING WATER,
Cornell Univ., Ithaca, NY. Graduate School.
J. S. Heath.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8708871. Ph.D. Dissertation, 1986. 287p, 8 fig, 2 tab, 84 ref, 4 append.

Descriptors: *Risks, *Communication, *Community development, *Groundwater pollution, *Decision making, Public participation, Public waters, Drinking water, Management planning, Surveys, Toxicity.

The relationship between non-local (federal, state, or county) risk managers and local decision-makers was studied in five communities with chemically contaminated groundwater used for public drinking water supply. Interviews were conducted and documents pertaining to risk management activities were reviewed. Follow-up interviews were held and public meetings were attended. Both the communication of risk-related information and actual management activities were studied. The management of toxicologic risk resulting from drinking water contamination is a process which communities define as unique and therefore one requiring outside intervention. Since outside intervenors define these problems in terms of generic response, the result is ineffective communication between participants in risk management, a lack of learning by local-level participants, and a bad reputation for intervening agencies. Effective risk management may require the participation of a neutral third party using the frameworks of integrated risk management and decision units. (Cremmins-AEPCO)
W89-08242

DESIGNING CONTAMINATED GROUNDWATER REMEDIATION SYSTEMS USING NUMERICAL SIMULATION AND NONLINEAR OPTIMIZATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. P. Ahlfeld.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8704591. Ph.D. Dissertation, 1987. 152p, 54 fig, 12 tab, 113 ref, 3 append.

Descriptors: *Water pollution control, *Groundwater pollution, *Water pollution prevention, *Model studies, *Simulation analysis, *Optimization, Sensitivity analysis, Aquifer systems, Pump wells, Finite element method.

Numerical simulation, nonlinear optimization and sensitivity theory were combined to design remediation strategies for contaminated groundwater aquifers. Models were developed to select the location and magnitude of pumping wells. Techniques were used to compute the derivative of concentration at some future point in time with respect to the convective and dispersive transport equation. The methods used were demonstrated on a large-scale simulation model of a Superfund site using two dimensional Galerkin finite elements. General conclusions were drawn about well placement for simple systems. For the groundwater remediation design problems that were solved, information was obtained on individual optimal solutions, tradeoffs between remediation effectiveness and operating cost, and levels of contaminant reduction which are not feasible. (Cremmins-AEPCO)
W89-08252

BALANCING PUBLIC AND PRIVATE INTERESTS IN WATER QUALITY PLANNING: MOTIVATIONS FOR PARTICIPATION,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6B.
W89-08258

TREATMENT SYSTEM FOR LANDFILL LEACHATE,
For primary bibliographic entry see Field 5D.
W89-08270

METHOD AND ARRANGEMENT FOR SEALING OFF DUMPS TO PREVENT SEEPAGE,
Zueblin (E.) A.G. Bauunternehmung, Stuttgart (Germany, F.R.).
E. Glaser.
U.S. Patent No. 4,678,369; July 7, 1987, 7p, 4 fig, 1 ref. Official Gazette of the United States Patent Office, Vol 1080, No 1, p248, July 7, 1987.

Descriptors: *Patents, *Waste disposal, *Water pollution control, *Land disposal, *Waste dumps, *Seepage control, Groundwater pollution, Water pollution control, Leakage, Sealants.

A wall is constructed around a dump area to prevent seepage of water into the surrounding ground and groundwater. At least one drainage sheet extends circumferentially around the dump area, including the peripheral length of the sealing wall. The sheet has a permeability value greater than that of the wall. A hydraulic gradient is produced in the wall relative to the surroundings by having the liquid level in the drainage sheet be lower than the level external to the wall. The occurrence and quantity of seepage water is determined in a controlled manner and accumulated seepage water is withdrawn from the drainage sheet. The quantity of seepage water withdrawn is measured and conclusion are drawn about the size of the leak and, by correlation to the pipes, about the position of the leak. (Cremmins-AEPCO)
W89-08280

MOBILE POND AERATING SYSTEM,
Aeras Water Resources, Inc., Eden Prairie, MN.
D. S. Arbisi, and C. E. Replogle.
U.S. Patent No. 4,680,148; July 14, 1987, 6p, 4 fig. Official Gazette of the United States Patent Office, Vol 1080, No 2, p 882-883, July 14, 1987.

Descriptors: *Patents, *Aerated lagoons, *Aerators, *Water quality control, Flotation, Lasers, Automation, Nozzles.

A self-propelled flotation unit is used for aerating substantially all areas of a pond of water surrounded by a bordering shoreline to enhance the environment for marine life. A subsurface aerating discharge nozzle is mounted on the unit for the discharge of aeration gas into the water below the surface. A programmer, which is also mounted on board the unit, is free from any connection with the shoreline and guides and propels the flotation on the water surface in a predetermined path so the aerating discharge for the nozzle effectively distributes the aerating gas with complete freedom of controlled movement. The electronic control

system computes and automatically controls the direction and speed of the unit. It includes a laser beam time transmitting device and reflecting mirrors mounted in fixed relation to the shore line of the pond to produce a flotation unit orienting signal. A system on board the unit senses the orienting signal to determine the angular position and automatically vary the direction of travel in accordance with the sensed position. (Cremmins-AEPCO)
W89-08281

MUNICIPAL GROUNDWATER CONTAMINATION IN MASSACHUSETTS: THE CASE FOR WELLHEAD PROTECTION IN HUMID REGIONS,
Massachusetts Univ., Amherst. Water Resources Research Center.
E. R. Kaynor.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-109771/AS, price codes: A10 in paper copy, A01 in microfiche. Publication No. 158, May 1988. 209p, 1 fig, 13 tab, 117 ref, 4 append. USGS contract 14-08-0001-G1314. USGS project G13143.

Descriptors: *Groundwater management, *Groundwater pollution, *Drinking water, *Public health, *Municipal water, *Massachusetts, Institutions, Water treatment, Aquifer management, Land use, Water supply, Water pollution sources, Chemical composition, Volatile acids, Organic compounds, Heavy metals, Toxicity, New England, Hydraulic gradient, Well regulations, Planning, Water policy, Governmental interrelationships.

Investigation of municipal groundwater contamination problems in Massachusetts reveals a wide array of approaches to reducing the problem. Generally, strategies of prevention (usually socio-political) were much more cost-effective than clean-up (usually engineering solutions). In humid regions, communities often have supply-source choices and have been able in the past to abandon contaminated sites, a least cost tactic, but environmentally degrading. Degree of success of preventive strategies is difficult to predict because of individual case differences. Unresolved tensions between levels of government exist with respect to appropriate roles in reducing problems of groundwater contamination. The most difficult institutional problem is the need for local action to solve local groundwater problems in home-rule states while, at the same time, local agencies often lack both the impersonalism and breadth of expertise to solve such problems. Yet higher levels of government with adequate expertise are reluctant to participate in traditionally local matters such as control of land use. Many of the 'friends and neighbors' types of local enforcement problems can be overcome by impersonal federal and state intervention. Massachusetts has achieved substantial success in controlling local groundwater contamination with imaginative state programs administered by generally dedicated environmental agencies. (Kaynor-U. MA, Amherst)
W89-08331

HAZARDOUS ORGANIC WASTES FROM NATURAL GAS PRODUCTS PROCESSING AND DISTRIBUTION: ENVIRONMENTAL FATES,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. A. Eiceman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-113948/AS, price codes: A05 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 227, November 1986. 87p, 33 fig, 14 tab, 79 ref. USGS state project 1345630.

Descriptors: *Toxicity, *Waste disposal, *Organic wastes, *Groundwater pollution, Polycyclic aromatic hydrocarbons, Benzene, Tolune, Xylenes, Fate of pollutants, Path of pollutants, Water pollution control, New Mexico, Duncan Oil Field.

Hydrocarbons and polycyclic aromatic hydrocarbons are generated as waste fluids and solids throughout all aspects of natural gas production, processing, and distribution. Wastes have often been and continue to be disposed in earthen unlined waste pits sometimes near vulnerable aquifers. Wastes move from pits through soils with no apparent abatement to depths greater than roughly 2 m. As expected, groundwater contamination does occur in river flood plains where depth to groundwater can be less than 2 m. Contamination of groundwater and nearby soils with hydrocarbons from an unlined pit was documented in the Duncan Oil Field west of Farmington, NM. Plumes for volatile compounds including benzene, toluene, and xylenes in the water and polycylic aromatic hydrocarbons in the soil were clearly evident downgradient from the earthen pit at distances up to 50 m. Waste pits containing produced water and hydrostatic discharge water were found to contain large amounts of polycyclic aromatic hydrocarbons which are phototoxic to fish. Legal or illegal discharges of natural gas wastes to surface waters should be reconsidered using not only salt and heavy metal contamination but also using toxicity and mutagenicity of aromatic hydrocarbons. (Eiceman-NM St U.)
W89-08348

WATER QUALITY IN REEDY FORK AND BUFFALO CREEK BASINS IN THE GREENSBORO AREA, NORTH CAROLINA, 1986-87,
Geological Survey, Raleigh, NC. Water Resources Div.
M. S. Davenport.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-4210, (1988). 134p, 16 fig, 15 tab, 29 ref.

Descriptors: *Water quality, *Trace elements, *Organic compounds, *Municipal water, Bottom sediments, Greensboro, North Carolina.

Water and bottom-sediment samples were collected April 1986 through September 1987 at 19 sites in the Greensboro, North Carolina, area. Sampling sites included streams, water supply lakes, drinking water, and effluent. A summary of nearly 22,000 separate chemical or physical analyses of water or bottom sediment are presented and discussed relative to the sample location or streamflow conditions. The analyses included 39 parameters of general water quality indicators, major ions, nutrients, and trace elements; 57 acid-base/neutral extractable compounds; 33 volatile organic compounds; and 41 organochlorine and organophosphorus pesticides. The qualities of raw and finished water, municipal effluents, and streams are compared to Federal and State standards or criteria. Inorganic constituents most commonly in excess of standards were iron, copper, zinc, arsenic, phosphorus, manganese, cyanide, and mercury. Relatively few organic compounds were detected, but those reported as exceeding standards were phthalate compounds, trihalomethane compounds, organophosphorus pesticides, and benzoic and phenolic compounds. Wilcoxon statistical analyses indicate differences in concentrations of some major ions among single sites in rural, semi-developed, and urban basins during low flow. Concentrations of some nutrients, major ions, and TOC were higher at the urban site than at the rural and semi-developed sites. There were no differences among sites in suspended sediment and some trace element concentrations. (USGS)
W89-08387

WATER QUALITY DATA, SAN JOAQUIN VALLEY, CALIFORNIA, MARCH 1985 TO MARCH 1987,
Geological Survey, Sacramento, CA. Water Resources Div.
L. R. Shelton, and L. K. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-479, (1988). 210p, 6 fig, 3 tab, 20 ref.

Descriptors: *Water quality, *Hydrologic data collections, On-site data collections, Environmental quality.

Water quality data were collected at numerous surface water and groundwater sites in the San Joaquin Valley, California, from March 1985 through March 1987. Streamflow and physical measurements were made, and water samples for analysis of major ions, trace elements, suspended sediments, and some pesticides were collected at varying frequencies at 11 continuing-record sites and 31 miscellaneous sites on the San Joaquin River and its tributaries. Physical measurements and water samples for analysis of major ions, trace elements, and some pesticides were collected at 285 groundwater sites in the western and southern San Joaquin Valley. (USGS)
W89-08388

U. S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1985-86,
Geological Survey, Reston, VA. Water Resources Div.
K. E. Goddard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-484, (1988). 158p, 13 fig, 58 tab.

Descriptors: *Hydrologic data, *Water quality, Biology, Sediment chemistry, Adsorption-desorption, Analysis techniques.

The Cheyenne River System in western South Dakota has been impacted by the discharge of about 100 million metric tons of gold-mill tailings to Whitewood Creek near Lead, South Dakota. In April 1985, the U.S. Geological Survey initiated an extensive series of research studies to investigate the magnitude of the impact and to define important processes acting on the contaminated sediments present in the system. The report presents all data collected during the 1985 and 1986 water years for these research studies. Some of the data included have been published previously. Hydrological, geochemical, and biologic data are available for sites on Whitewood Creek, the Belle Fourche and Cheyenne Rivers, and for the Cheyenne River arm of Lake Oahe. Data complexity varies from routine discharge and water quality to very complex photon-correlation spectroscopy and energy-dispersive x-ray analysis. Methods for sample collection, handling and preservation, and laboratory analysis are also presented. No interpretations or complex statistical summaries are included. (USGS)
W89-08390

TREATMENT OF WATER SUPPLIES CONTAMINATED WITH TOXIC POLLUTANTS USING TAILORED SOILS,
New Mexico Water Resources Research Inst., Las Cruces.
F. Cadena.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-151443/AS, price code: A04 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 235, November 1988. 54p, 14 fig, 7 tab, 44 ref. USGS state project 1345668.

Descriptors: *Adsorption, *Hazardous materials, *Organic compounds, *Clays, *Groundwater pollution, *Wastewater renovation, Pollutants, Water treatment, Soil adsorption capacity, Organophilic coatings, Hydrocarbons, Ion exchange, Tetraalkylammonium ions, Cation exchange capacity.

Natural clays have a large internal surface area that is potentially available for adsorption of hazardous organic compounds. The exchangeable cations in clays occupy the interlamellar spaces that separate the clay platelets. Water molecules form a hydrated shell around the exchangeable cations due to the hydrophilic nature of these ions. The presence of such water molecules hinders adsorption of hydrophobic organic pollutants. The interlamellar area in clays is normally inaccessible to organic pollutants. Restoration of aquifers affected

by petrochemicals may be accomplished by flushing the aquifer through natural soils that have been previously tailored with tetraalkylammonium (TAA+) molecules. The modified soils can be selectively tailored to preferentially adsorb targeted hazardous substances. This innovative process for the removal of BTX (benzene, toluene and xylenes) from groundwater contaminated by gasoline and other petrochemical spills is expected to be both economically and technically feasible. The adsorptive properties of TAA+ tailored soils for the selective removal of hazardous organic pollutants found in waters contaminated by petrochemical spills was investigated. Effectiveness of the tailoring agents was evaluated by comparing adsorption isotherms of BTX on treated and untreated soils. Column studies were performed to estimate kinetic properties of the tailored and untailored natural soils. Modelling of pollutant transport in the column studies was used to obtain engineering design parameters. (USGS)
W89-08438

AMMONIA AND PH TOXICITY AND WATER QUALITY MANAGEMENT FOR FRESHWATER SHRIMP,
Mississippi State Univ., Mississippi State. Dept. of Wildlife and Fisheries.
For primary bibliographic entry see Field 5C.
W89-08443

PLASMID PROFILE ANALYSIS FOR ASSESSING BACTERIOLOGICAL QUALITY OF NATURAL WATERS,
University of Southern Mississippi, Hattiesburg. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-08444

SEDIMENTATION AND WATER QUALITY IN WEST BRANCH SHADE RIVER BASIN, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08460

PRACTICAL HANDBOOK OF ENVIRONMENTAL CONTROL.
CRC Press, Inc., Boca Raton, Florida. 1989. 537p. Edited by Conrad P. Straub.

Descriptors: *Data collections, *Environmental control, *Water pollution prevention, *Environmental protection, *Handbooks, Water quality, Wastewater treatment, Industrial water, Municipal wastewater, Solid wastes, Institutional constraints.

This book contains over 500 pages environmental information presented in tabular form. Major sections covered include: air, water sources and quality, wastewater, solid waste, and institutional considerations. The biological effects of various air pollutants, industrial water quality tolerances, and the composition and analysis of municipal refuse are just a sample of the tabular data presented. (Lantz-PTT)
W89-08469

SUPERFUND RECORD OF DECISION: FMC CORP., MN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-221015. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/059, September 1987. 677p, 7 fig, 1 tab.

Descriptors: *Chemical wastes, *Water pollution control, *Water quality control, *Superfund, *Groundwater pollution, *Cleanup operations, *Waste disposal, *Minnesota, Hazardous wastes, Soil contamination, Volatile organic compounds, Aquifers, Costs, Trichloroethylene, Benzene, Organic compounds, Xylene, Monitoring, Path of pollutants.

The FMC site is located in the City of Fridley, Minnesota, approximately 1,000 ft east of the Mississippi River, just north of the City of Minneapolis, upstream of Minneapolis' drinking water intake which serves about 500,000 people. This groundwater operable units addresses those portions of the site known as the FMC lands (13 acres) and the Burlington Northern Railroad Company lands (5 acres). From 1941 to 1964 Northern Ordnance, Inc. operated as a naval ordnance manufacturing complex at the site. Between 1945 and 1969 a tract of land south of the complex was used for the burning and disposal of wastes, including plating wastes, paint, paint sludges, oils, bottom ash, and chlorinated and non-chlorinated solvents. In 1964 the FMC Corporation purchased the property and continued to use the waste disposal area. By June 1983, approximately 38,600 cu yd of contaminated soil with volatile organic compound (VOC) concentrations > 1mg/kg were excavated from the unsaturated zone beneath and in the area of the waste burn and disposal pits and placed in a Resources Conservation and Recovery Act onsite containment and treatment facility. Currently underlying groundwater and alluvial aquifers with discharge to the Mississippi River are contaminated with trichloroethylene (TCE), benzene, toluene, xylene and other VOCs. TCE has been estimated to account for 98% of the contaminant loading. The selected remedial action for this site includes: groundwater pump and treatment with discharge to a publicly operated treatment work (sewer system); groundwater monitoring; and implementation of institutional controls with land use restrictions to mitigate near-term usage of contaminated groundwater between the site and the Mississippi River. The estimated capital cost for this remedial action is $773,935 with present worth operation and maintenance of $744,870. (Author's abstract)
W89-08473

SUPERFUND RECORD OF DECISION: SAND SPRINGS PETROCHEM, OK (SOURCE CONTROL O.U.),
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-221023. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R06-87/024, September 1987. 94p, 2 fig, 5 append.

Descriptors: *Chemical wastes, *Water pollution sources, *Water pollution control, *Water quality control, *Superfund, *Waste disposal, *Cleanup operations, *Oklahoma, *Soil contamination, Groundwater pollution, Costs, Organic compounds, Hazardous wastes, Solidification, Lead, Zinc, Chromium, Barium, Toluene, Volatile organic compounds.

The Sand Springs Petrochemical Complex is a 235-acre site in Sand Springs, Oklahoma on the northern bank of the Arkansas River. The site includes acid sludge pits, a surface impoundment, spray ponds, solvent and waste lagoons, surficial sludge contamination, solvent and waste oil lagoons and contaminated sediments. The total known waste volume is approximately 130,000 cu yd. Sulfuric acid sludge exists in unlined sludge pits and heavy metal and organic wastes are contained in the lagoons, pits and spray ponds. While both soil and groundwater are contaminated, this first operable unit source control Record of Decision (ROD) addresses surface liquids, sludges and heavily contaminated soils. The primary contaminants of concern are organic pollutants: bis(2-ethylexyl)phthalate and toluene and inorganic compounds: lead, zinc, chromium and barium. The selected remedial action for this site is onsite thermal destruction of wastes. The estimated capital cost of this remedial action is approximately $66,500,000 with annual operation and maintenance of $15,000. During the ROD's comment period, ARCO Petroleum Products Company, one of the potentially responsible parties (PRPs), formally proposed a privately-financed remedy for this site, which is similar to an alternative evaluated by EPA. Components of ARCO's proposed remedy include: excavation and offsite thermal destruction of sludges; solidification and/or stabilization of all remaining sludges with containment of the resulting matrix in an onsite hazardous waste RCRA cell; and implementation of chemical and physical treatability studies. The estimated capital cost of this remedial action is $37,453,050 with annual operation and maintenance of $15,000. PRP replacement costs total $100,000,000. (Lantz-PTT)
W89-08474

SUPERFUND RECORD OF DECISION: WILLIAMS PROPERTY, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-159934. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-87/044, September 1987. 78p, 2 fig, 13 tab.

Descriptors: *Chemical wastes, *Soil contamination, *Path of pollutants, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, *New Jersey, Organic compounds, Volatile organic compounds, Xylene, Incineration, Water pollution sources, Costs.

The Williams Property site, a 5.6-acre tract of land containing a single residence, is located in Middle Township, Cape May County, New Jersey. The site is wooded and surrounded by land zoned for agricultural and residential use. In 1979, approximately 150 drums of liquid chemical wastes and sludge were emptied on the Williams Property. The New Jersey Department of Environmental Protection (NJDEP) investigated to determine the nature and extent of the contamination and the impact of the spill on the environment, particularly the groundwater. The results indicated extensive contamination of surficial sludge, contamination of soil and groundwater with heavy metals and a wide variety of organic chemicals. In June 1980, NJDEP removed approximately 1,200 cu yd of sludge and soil. Continued evidence of groundwater contaminants forced the closing of the Williams' well in 1984. It was subsequently discovered that widespread dumping of refuse and construction debris had occurred on the site for years. This dumping may have contributed to groundwater contamination. Primary contaminants of concern include: bis (2-ethylhexyl) phthalate, PCE, methylene chloride and xylene. The selected remedial action for the site includes: extraction and treatment of contaminated groundwater with discharge to the underlying aquifer; excavation (700 cu yd) and offsite incineration of contaminated soil; regrading, backfilling (clean soil) and revegetation; and provision of an alternate water supply to nearby residents with contaminated wells. The estimated capital cost of the remedial action is $513,750 with annual operation and maintenance of $64,000. (Author's abstract)
W89-08475

SUPERFUND RECORD OF DECISION: ROSE TOWNSHIP, MI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-159983. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/052, September 1987. 170p, 16 fig, 24 ref.

Descriptors: *Chemical wastes, *Path of pollutants, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Michigan, *Groundwater pollution, *Waste disposal, Polychlorinated biphenyls, Trichloroethylene, Solvents, Organic compounds, Aromatic compounds, Incineration, Chemical treatment, Water pollution sources costs.

The Rose Township Dump site is located in rural Rose Township, Oakland County, Michigan. The 110-acre site comprises an upland area almost completely surrounded by wetlands, with an abundance of wildlife onsite. From 1966 to 1968 an unknown number of drums containing solvents, paint sludges and PCBs were buried in a 12-acre portion of the site. Bulk wastes were also discharged to the surface or into shallow lagoons or pits in the area. In June 1979, the Michigan De-

partment of Natural Resources tested domestic wells in the area and found low level trichloroethylene (TCE) and perchloroethylene (PCE) contamination. This contamination made it necessary to supply bottled water to residents. Based on 1979 drum sampling results, funds were appropriated for an immediate removal action, which disposed of over 5,000 drums offsite. Further testing between 1980 and 1982 indicated the presence of organic chemical contamination in the groundwater. Currently, the primary contaminants of concern affecting the soil and groundwater include: VOCs, PAHs, PCBs, organics and inorganics. The selected remedial action includes: excavation of as much as 50,000 cu yd of contaminated soil; onsite thermal destruction of contaminants in the excavated soil with disposal of resultant ash; groundwater pump and treatment using chemical coagulation, air stripping and activated carbon adsorption with discharge to an appropriate place. The estimated capital cost for this remedial action is $32,547,000 with annual operation and maintenance of $200,000 for year 0-10 and $70,000 for year 11-30. (Author's abstract)
W89-08476

SUPERFUND RECORD OF DECISION: STRINGFELLOW ACID PITS, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220934. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R09-87/016, June 1987. 39p, 9 fig, 4 tab.

Descriptors: *Superfund, *Cleanup operations, *Hazardous materials, *Runoff, *Path of pollutants, *Water quality control, *Water pollution control, *Groundwater pollution, *Waste disposal, *California, DDT, Organic compounds, Wastewater treatment, Chemical treatment, Volatile organic compounds, Trichloroethylene, Heavy metals, Costs.

The Stringfellow site is located in Riverside County, California. Between August 1956 and November 1972, the Stringfellow Quarry Company operated a hazardous waste disposal facility at the site. Approximately 34,000,000 gallons of industrial waste, primarily from metal finishing, electroplating, and DDT production were deposited in onsite evaporation ponds. Spray evaporation procedures were used to accelerate the reduction of pond content volume. In 1972, the site was voluntarily closed. In 1969 and 1978, excessive rainfall caused the disposal ponds to overflow into Glen Avon. In 1980 and 1981, the Santa Ana Regional Water Quality Control Board implemented an Interim Abatement Program at the site, as the first phase of site closure. The program included removal of all surface liquids; partial neutralization and capping of wastes; installation of a gravel drain and an onsite downgradient well network; surface water diversion channels; and construction of a downgradient clay core barrier dam and leachate collection system. A July 1984 record of decision (ROD) approved of the installation of an onsite groundwater facility using lime precipitation for heavy metals followed by granular activated carbon treatment for the removal of organics, with initial discharge to publicly owned treatment works (POTW) and final discharge to the ocean. The primary contaminants of concern affecting onsite and downgradient groundwater include: volatile organic compounds (VOCs) included trichloroethylene, organic compounds, inorganic compounds, and metals. The selected remedial action for this site includes: installation of a groundwater barrier system in the lower canyon area and treatment of extracted groundwater, if necessary, followed by discharge to a POTW; installation of a peripheral channel around the north end of the original site to direct upgradient surface water runoff; and extension of the existing gunite channels southward to discharge surface water to Pyrite Creek. The estimated capital cost for the selected remedy is $1,047,000-$1,136,000 with annual operation and maintenance costs of $1,243,000-$1,408,000. (Author's abstract)
W89-08477

SUPERFUND RECORD OF DECISION: SOUTH BRUNSWICK, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220942. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-87/052, September 1987. 87p, 3 fig, 1 tab, 5 append.

Descriptors: *Municipal wastes, *Industrial wastes, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, *New Jersey, Landfills, Water pollution sources, Brunswick, Volatile organic compounds, Iron.

The Browning-Ferris Industries South Brunswick Landfill (BFI) is a closed landfill situated on approximately 68 acres in Middlesex County, New Jersey. The landfill is located adjacent to a school, park and private residence, although a substantial portion of the landfill is surrounded by woods. The site is in close proximity to a brook that feeds into a public drinking water supply 10 miles downstream. For more than twenty years the site operated, under two separate owners, as a solid waste landfill that received municipal refuse, pesticides, chemical wastes and hazardous wastes. Pursuant to a closure order from the New Jersey Department of Environmental Protection (NJDEP) July 1978, the site was officially closed in December 1978. In June 1980 EPA conducted a site investigation that revealed elevated levels of volatile organic compounds (VOCs) and iron in the groundwater and surface water. The selected containment remedy for the site has been in place and operational since September 1985. This Record of Decision (ROD) evaluates the remedy selection process in the context of Superfund Amendments and Reauthorization Act of 1986 (SARA). The selected remedial action for this site includes onsite containment (leachate collection/treatment system, slurry wall, clay cap, gas venting system), which was initiated in May 1983 and completed on September 1985; and post-remedial groundwater, surface and air monitoring. (Author's abstract)
W89-08478

SUPERFUND RECORD OF DECISION: PALMETTO WOOD PRESERVING, SC.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-159967. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-87/026, September 1987. 45p, 13 fig, 14 tab.

Descriptors: *Chemical wastes, *Soil contamination, *Path of pollutants, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, *South Carolina, Costs, Industrial wastewater, Chromium, Pentachlorophenol, Water pollution sources, Dinitrophenol, Phenols, Copper, Physical treatment, Chemical treatment.

The Palmetto Wood Preserving (PWP) Site is located in the rural community of Dixiana, South Carolina. The 5-acre site is a decommissioned wood preserving facility which operated between 1963 and 1985. PWP began operating in 1963 using a fluoride-chromate arsenate-phenol and an acid-copper-chromate process. In 1980, Eastern Forest Products took over and switched to a chromate-copper-arsenate (CCA) process. Operations consisted of impregnating wood with a CCA solution under high pressure, and allowing the wood to drip-dry under normal conditions. Beginning in December 1981, the South Carolina Department of Health and Environmental Control (SCDHEC) received complaints of green liquids running off the PWP site during heavy rainfall. Subsequent soil sampling conducted by SCDHEC indicated the presence of high concentrations of chromium. Pentachlorophenol (PCP) and dinitrophenol residues were also detected. Well water sampling showed no evidence of contamination. In April 1983, a private well was found to contain high levels of chromium and copper. As a result of the findings, SCDHEC issued a Consent Order requesting Palmetto Wood Preserving to determine the extent of soil and groundwater contamination. Primary contaminants of concern include chromium and arsenic. The selected remedial action for the site includes: extraction, filtration and onsite treatment of contaminated groundwater with discharge to a nearby stream; installation of a municipal water line or new well for a private residence; excavation, onsite flushing and onsite replacement of contaminated soils, with onsite treatment of flushing solution. The estimated capital cost of the remedy is $1,393,000 with annual operation and maintenance costs of $176,163. (Author's abstract)
W89-08479

SUPERFUND RECORD OF DECISION: SAN FERNANDO VALLEY, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220405. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R09-87/014, September 1987. 66p, 2 fig, 3 tab.

Descriptors: *Chlorinated hydrocarbons, *California, *Path of pollutants, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, Water pollution sources, Trichloroethylene, Volatile organic compounds, Costs, Activated carbon, Perchloroethylene.

The North Hollywood-Burbank Well Field is one of four NPL sites in San Fernando Valley, CA. It is located within in the San Fernando Valley Ground Water basin, which can provide drinking water for approximately 500,000 people residing in the San Fernando Valley and Los Angeles. In 1980 trichloroethylene (TCE) and perchloroethylene (PCE) were discovered in 25% of the Los Angeles Department of Water and Power (DWP) wells. In July 1981 DWP and the Southern California Association of Governments began a 2-year study funded by EPA. The study revealed the occurrence of groundwater contamination plume patterns that are spreading toward the southeast. Following the completion of the study, DWP began a program to control the spread of contamination, which included preferential pumping and bleeding of the contaminated groundwater with uncontaminated surface water supplies. The primary contaminant of concern to the groundwater is TCE with PCE and other volatile organic compounds present. The selected remedial action for this site is groundwater pump and treatment using aeration and granular activated carbon-air filtering units, with discharge to the DWP Pumping Station for chlorination and distribution. Spent carbon will be removed and replaced with fresh carbon, with the spent carbon scheduled either for disposal or regeneration. The estimated capital cost for this remedial action is $2,192,895 with present worth operation and maintenance of $2,284,105. (Author's abstract)
W89-08480

SUPERFUND RECORD OF DECISION: NEW BRIGHTON/ARDEN HILLS/TCAAP, MN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PPB88-221007. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/058, September 1987. 75p, 2 fig, 7 tab.

Descriptors: *Chemical wastes, *Minnesota, *Water pollution control, *Water quality control, *Superfund, *Cleanup operations, *Groundwater pollution, *Waste disposal, Organic compounds, Costs, Polychlorinated biphenyls, Benzene, Toluene, Trichloroethylene, Volatile organic compounds, Arsenic, Chromium, Lead, Heavy metals, Monitoring, Path of pollutants.

The Twin Cities Army Ammunition Plant (TCAAP) is located north of the Twin Cities of Minneapolis/St. Paul, Minnesota and comprises the northern edge of the New Brighton/Arden

Hills/St. Anthony Superfund NPL site. The U.S. Army estimates approximately 26 lb/day of volatile organic compound (VOC) contaminants are migrating off TCAAP into the groundwater at the southwest boundary of TCAAP. This contamination is migrating in both the Hillside Sand Aquifer and the deeper Prairie du Chien/Jordan Aquifer (both are aquifers that supply water to the cities of New Brighton and St. Anthony). Both of these cities have made modifications to their water supply due to groundwater contamination. The primary contaminants of concern affecting the groundwater include: PCBs, benzene, toluene, trichloroethylene, VOCs, arsenic, chromium, lead and metals. The selected remedial action for this site includes: operation of a six-well system to extract groundwater migrating from the southwest corner of TCAAP and treatment with air stripping. Approximately 300,000 gallons/day will be utilized for in-plant use with the remainder disposed of by reinjection/infiltration through the arsenal sand and gravel pit; evaluation of operating data and monitoring results and implementation of any additional measures required to capture contaminated groundwater migrating from the site. The estimated capital cost for this remedial action is $4,000,000 with annual operation and maintenance costs of $120,000. (Lantz-PTT)
W89-08481

SUPERFUND RECORD OF DECISION: CENTRAL CITY/CLEAR CREEK, CO.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220983. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R08-87/018, September 1987. 159p, 1 fig, 6 tab, 3 append.

Descriptors: *Water pollution control, *Water quality control, *Cleanup operations, *Acid mine drainage, *Path of pollutants, *Superfund, *Colorado, Stream pollution, Groundwater movement, Seepage, Metals, Environmental effects, Wastewater treatment, Water quality criteria, Waste disposal, Runoff, Precipitation, Operating costs, Maintenance costs.

The Clear Creek/Central City site encompasses portions of Clear Creek County and Gilpin County in the Colorado Mineral Belts, CO. More specifically, the focus is on five abandoned mines/tunnels proximal to the cities of Idaho Springs, Black Hawk and Central City and the influence of acid mine drainage from those tunnels on adjacent stream courses. Surface water contamination results from acid mine drainage emanating from the five tunnels and from seepage of groundwater through tailings piles both proximal to these tunnels and along stream courses. Approximately 1,200 lbs/day of dissolved and suspended metals are discharged to the Clear Creek drainage from the five mine tunnels. These dissolved and suspended metal loadings have resulted in a significant depletion of aquatic life and have potential impact to sediments and downstream users of surface and groundwater. There are ten contaminants of concern including aluminum, arsenic, cadmium, chromium, copper, fluoride, lead, manganese, nickel, silver and zinc. The selected interim remedy for this site includes: construction of passive treatment systems to treat mine tunnel discharge prior to discharge to surface water. This is the preferred alternative and is contingent upon results of ongoing pilot plant studies. If water quality concentrations cannot be achieved by passive treatment, either a combination system of passive and active treatment systems will be constructed or two active treatment systems (chemical precipitation or electrochemical precipitation) will be constructed to treat mine tunnel discharge. The estimated capital cost for passive treatment only is $1,663,000 with annual operation and maintenance costs of $115,000. (Author's abstract)
W89-08482

SUPERFUND RECORD OF DECISION: LASKIN POPLAR OIL, OH (2ND O.U.).
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161 as PB88-159991, price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/053, September 1987. 54p, 2 fig, 2 tab.

Descriptors: *Water pollution control, *Water quality control, *Wastewater pollution, *Superfund, *Cleanup operations, *Water pollution sources, *Waste disposal, Astabula, Ohio, Oil pollution, Polychlorinated biphenyls, Hazardous wastes, Solidification, Incineration, Polyaromatic hydrocarbons, Volatile organic compounds, Lead, Waste treatment.

The Laskin/Poplar Oil site, occupying approximately 9 acres, is located in Astabula County, Ohio. Approximately 80 years ago a greenhouse operation was begun on the site. Boilers were installed approximately 30 years ago to heat the greenhouses. During the 1960's, tanks were installed to hold waste oil to fire the boilers. The oils were not analyzed prior to acceptance and oil containing PCBs and other hazardous constituents were accepted. As the greenhouse business deteriorated, the owner began collecting, reselling and disposing of waste oils containing PCBs and other hazardcus constituents. Several emergency actions were taken after the site was discovered and during critical periods such as mudslides and flooding. Between July and October 1982, a planned removal action removed 302,000 gallons of waste oil, solidified 205,000 gallons of sludge and treated and released 430,000 gallons of contaminated water. An August 1984 Record of Decision addressed the incineration of contaminated water, oil above 50 ppm (parts per million), PCB and oil below 50 ppm PCB. Currently bulk waste material including 6,000 gallons of oil, 60,000 gallons of waste water and 705,000 gallons of sludge are still present at the site. The primary contaminants of concern affecting the soil include: PCBs, PAHs, VOCs and metals (primarily lead). The selected remedial alternative includes: construction of a fence around contaminated portions of the site and the onsite incinerator; onsite incineration of oils, sludges and highly contaminated soils; offsite treatment of all wastewaters, decontamination water and scrubber water; offsite disposal of all incinerator ash; dismantling and offsite disposal of all tanks; crushing and incineration of cinder block walls of the pits; and backfilling and grading of all excavated areas. The estimated present worth of the recommended alternative is $8.5 million with no operation and maintenance required. (Author's abstract)
W89-08494

SUPERFUND RECORD OF DECISION: OPERATING INDUSTRIES, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161 as PB88-220397, price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R09-87/013, July 1987. 21p, 6 fig, 2 tab.

Descriptors: *Water pollution control, Water quality contorl, *Waste disposal, *Landfills, *Superfund, *Cleanup operations, *Water pollution sources, Monterey Park, California, Leachates, Organic compounds, Volatile organic compounds, Trichloroethylene, Vinyl chloride, Benzene, Toluene, Monitoring, Costs.

The Operating Industries, Inc. (OII) site, consisting of a 190-acre landfill, is located in Monterey Park, California. From 1948 to 1952, the site was used to dispose of municipal garbage by the City of Monterey Park. Prior to 1948, the site and surrounding areas were quarried for sands and gravels. Between 1952 and 1984, under the private ownership of OII, the landfill received municipal and industrial liquid and sludge wastes. The construction of a freeway in 1974, split the landfill into a north and south parcel. By June 1975, waste disposal operations curtailed in the northern parcel, limiting operations to the area south of the freeway. In 1954, the Regional Water Quality Control Board permitted disposal of liquids at the site. Some of these liquids, and some liquid industrial wastes disposed prior to the Board's permit, are considered hazardous by current statutes and regulations. In 1975, a 32-acre area in the southern parcel was permitted to accept Class II-1 wastes. Waste disposal operations ceased in October 1984. In 1979, Getty Synthetic Fuels, Inc. (GSF), having established a contractual relationship with OII for the extraction of gas from the landfill, began gas processing activities (GPA). EPA took over operations of GPA in June 1987 following a decision by GSF to abandon activities at the landfill. EPA has been conducting site control and monitoring activities at the site since May 1986. Additionally, EPA has conducted a number of emergency actions to mitigate potential threats to public health and the environment. Leachate generated at the site is a hazardous waste as defined by RCRA regulations and contains VOCs including trichloroethylene, vinyl chloride, benzene, and toluene. The selected remedial action for this site includes control and monitoring activities. The first control component is operation and consists of opening/closing valves, starting motors and other mechanical functions. Maintenance is the second control component and can consist of repairs to existing systems of preventive maintenance and improvements. Gas wells and leachate pumping and collection will be monitored. The estimated present worth cost for this interim remedy is $5,100,000. (Author's abstract)
W89-08495

SUPERFUND RECORD OF DECISION: MARION/BRAGG LANDFILL, IN.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response. Available from the National Technical Information Service, Springfield, VA 22161 as PB88-160015, price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/055, September 1987. 70p, 4 fig, 5 tab, 7 ref.

Descriptors: *Water pollution control, *Water quality control, *Water pollution prevention, *Superfund, *Landfills, *Cleanup operations, *Water pollution sources, Acetone, Marion, Indiana, Organic compounds, Waste disposal, Solidification, Costs, Dichloroethylene, Trichloroethylene, Vinyl chloride, Volatile organic compounds, Capping, Monitoring, Groundwater pollution, Potable water.

The Marion/Bragg Landfill is a 72-acre site located near the southeastern city limits of Marion, Indiana. The site is bordered on the north and east by the Mississinewa River. Main features of the site include a 45-acre landfill and a 15-acre pond. From 1935 to 1961 the site was used as a sand and gravel quarry, and from 1949 to 1970 portions of the site, leased by Radio Corporation of America and Bragg Construction Company, were used for industrial and municipal waste disposal. Throughout this period, the Indiana State Board of Health (ISBH) noted the disposal of acetone, plasticizers, lacquer thinner and enamels. Drummed wastes were also accepted and contents were alledgedly emptied from the drums and worked into the landfill waste with a bulldozer, causing several fires on site. Drums were allegedly rinsed and resold. In 1975 Bragg Construction company ceased operation of the landfill. In 1975, Waste Reduction Systems constructed a transfer station to properly transfer solid wastes to an approved landfill. The transfer station was closed in 1977. The landfill contains approximately 1,100,000 cu yd of waste. Primary contaminants of concern include: dichloroethylene, trichloroethylene vinyl chloride, and other VOCs. The selected interim remedial action for the Marion/Bragg landfill includes: capping with regrading; providing and maintaining flood control measures to protect the portion of the site within the 100-year flood plain; fence construction; providing three private wells for drinking water; sealing shallow wells; and monitoring groundwater to determine effectiveness of the interim remedy. Additional studies will be conducted to determine remedies for groundwater and the onsite pond. The estimated capital cost of the selected interim remedy is $5,800,000, with present worth operation and maintenance of $1,000,000. (Author's abstract)
W89-08497

SUPERFUND RECORD OF DECISION: SCHMALZ DUMP, WI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-160007, price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R05-87/054, September 1987. 48p, 12 fig, 2 tab.

Descriptors: *Water pollution control, *Water quality control, *Water pollution prevention, *Superfund, *Water pollution sources, *Cleanup operations, Harrison, Wisconsin, Waste disposal, Wetlands, Polychlorinated biphenyls, Lead, Chromium, Groundwater pollution, Monitoring, Costs, Capping.

The Schmalz Dump site occupying approximately seven acres of the Waverly Beach wetlands area, is located on the north shore of Lake Winnebago in the town of Harrison, Wisconsin. Industries dumped wastes at various locations along the north shore of Lake Winnebago for several years. The previous site owner began filling his property in 1968. Records show that wastes hauled there consisted of solid wastes, car bodies, stone, trees, pulp chips and mash. Between 1972 and 1973 the site accepted fly ash and bottom ash from Menasha Utility, and in 1978 and 1979 Schmalz accepted the demolition debris of a building owned by the Allis-Chalmers Corporation. Initial onsite sampling in early 1979 determined that an area containing the Allis-Chalmers debris was contaminated with concentrations of PCBs as high as 3,100 ppm with lead and chromium also detected in relatively high concentrations. In August 1985, a record of decision (ROD) was signed approving an operable unit to address the PCB contamination. This second operable unit addresses soil contamination with lead and chromium +3. The selected remedial action for this site includes: the installation of a low permeability, compacted earth material cap over approximately seven acres of lead and chromium contaminated soils; and implementation of groundwater monitoring involving the installation of slurry wall for lead and chromium. A voluntary well abandonment program for nearby wells is also proposed. The estimated capital cost for remedial action is $687,664 with annual operation and maintenance of $17,940. (Author's abstract)
W89-08511

WATER MANAGEMENT: WATER QUALITY CONTROL,
National Inst. for Water Research, Pretoria (South Africa).
H. J. Best.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-207071, price codes: E03 in paper copy, E03 in microfiche. October 31, 1986. 10p.

Descriptors: *Water quality control, *Water quality management, *South Africa, Water treatment, Water pollution control, Water pollution prevention.

The Republic of South Africa is a water deficient country. Present water quality control strategy is aimed at supplementing natural resources with effluents purified at source to blanket standards. Pollution control will in the future be based on a policy of integrated river basin management with receiving water quality related standards which will be better adapted to fit the needs of users in specific regions. (Author's abstract)
W89-08518

SULFATE REDUCTION IN THE SEDIMENTS OF THE TIDAL ELBE (SULFAT-REDUKTION IN SEDIMENTEN DER TIDEELBE),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
H. Tiedemann, and R.-D. Wilken.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-753776. Price codes: A03 in paper copy, A01 in microfiche. Report No. RKSS--87/E/53, 1987. 37p, 9 fig, 5 tab, 46 ref.

Descriptors: *Tidal rivers, *Bottom sediments, *Sulfates, Sediment contamination, Elbe River, Temperature.

Sulfate reduction rates were measured at three sampling locations in the tidal influenced Elbe River (Oortkaten, Muhlenberger Loch, Neufelder Watt), using the S-35 technique, from the autumn of 1984 through the summer of 1985. The average water discharge was about 750 cu m/sec. The sulfate reduction rates were measured at different depths (every 2 cm). The reduction was normal at first, depending on the temperature of the sample, in the first 2 cm. However, two zones of higher rates were often found down to a depth of 35 cm. Reduction occurred not only in the temperature range of 15-20 C, but also down to temperatures of 4 C (more than 100 nanomol SO4(2-)/cu cm/d). (Author's abstract)
W89-08524

WASTEWATER AND HAZARDOUS WASTE SURVEY, ENGLAND AFB LA,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5D.
W89-08525

SUPERFUND RECORD OF DECISION: LIQUID DISPOSAL, MI.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-159975, price codes: A04 in paper copy, A01 in microfiche. Report No. EOA/ROD/R05-87/051, September 1987. 67p, 2 fig, 5 tab.

Descriptors: *Waste disposal, *Groundwater pollution, *Path of pollutants, *Michigan, *Superfund, *Liquid, *Cleanup operations, Water pollution treatment, Heavy metals, Landfills, Volatile organic compounds, Polychlorinated biphenyls, Barium, Cadmium, Lead, Inorganic compounds, Solidification, Costs, Fixation.

Liquid Disposal, Inc. (LDI) is a 6.8-acre site located in a residential/light industrial area in Shelby Township, Michigan. LDI is bordered by the Clinton River and its flood plain, the Shadbush Tract Native Study Area and automobile junkyards. The site was first used as a source of sand and gravel prior to becoming a landfill around 1964. Between 1968 and 1982, LDI operated as a commercial incinerator of liquid waste. During this time, the site contained a large volume of hazardous substances stored in the waste oil and scrubber lagoons, ash sludge piles, above and below ground storage tanks and in 55-gallon drums. Since 1982, EPA has completed four immediate removal actions. As a result of these actions, no surface waste sources exist at the site. However, several hundred waste sample jars, old incinerator parts, emptied tanks, wooden pallets, miscellaneous containers and other debris remain onsite. Currently, on and offsite soil and groundwater (the upper aquifer) are contaminated with a wide variety of organic and inorganic chemicals. Onsite concentrations are generally higher than offsite. The primary contaminants of concern include: VOCs, semi-volatile organics, PCBs, barium, cadmium, and lead. The selected remedial action for this site includes: onsite land disposal of all existing debris and equipment; onsite solidification/fixation of soil and waste; groundwater pumping and treatment using air stripping and ion exchange with discharge to Clinton River; and construction of a slurry wall and impermeable cap containment system. The estimated capital cost of this remedial action is $21,743,100 with present worth operation and maintenance of $316,600. (Author's abstract)
W89-08530

TOXICITY REDUCTION EVALUATION AT THE PATAPSCO WASTEWATER TREATMENT PLANT,
Engineering Science, Fairfax, VA.
For primary bibliographic entry see Field 5D.
W89-08531

CALCULATION OF THE FINAL ACUTE VALUE FOR WATER QUALITY CRITERIA FOR AQUATIC ORGANISMS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
R. J. Erickson, and C. E. Stephan.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-214994. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/018, June 1988. 55p, 1 fig, 8 tab, 12 ref, append.

Descriptors: *Lethal limit, *Aquatic life, *Statistical methods, *Bioassay, *Water quality standards, *Toxicity, *Water pollution effects, Aquatic environmental, Final acute value, Statistical analysis.

The Final Acute Value (FAV) for a material, which is an integral part of the procedure for deriving water quality criteria for aquatic organisms, is an estimate of the fifth percentile of a statistical population represented by the set of Mean Acute Values (MAV) available for the material; a MAV being the concentration of the material that causes a specified level of acute toxicity to aquatic organisms in some taxonomic group. A new procedure for calculating FAVs has been developed under the assumption that sets of MAVs are random samples of such populations. Based on examination of available sets of MAVs, it was inferred that FAV estimation would be best served by assuming that the populations have a log triangular distribution. Also, because this or any other assumption will likely not completely hold over the entire range of data in all sets, it was judged that FAV estimation should be based on a subset of the data near the fifth percentile. Major modifications of the new procedure were found to result either in only minor changes in FAVs or in FAVs at variance with the data. A procedure based on extreme deviation from random sampling generally did not produce greatly different FAVs. (Author's abstract)
W89-08537

IN SITU BIOLOGICAL TREATMENT TEST AT KELLY AIR FORCE BASE, VOLUME II: FIELD TEST RESULTS AND COST MODEL,
Science Applications, Inc., McLean, VA.
R. S. Wetzel, C. M. Durst, D. H. Davidson, and D. J. Sarno.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A87 486. Price codes: A06 in paper copy, A01 in microfiche. Report ESL-TR-85-52, Vol. II, July 1987. Final Report. 156p, 34 fig, 20 tab, 22 ref.

Descriptors: *Chemical wastes, *Soil contamination, *Decontamination, *Water pollution treatment, *Biological treatment, *Groundwater pollution, *Field tests, *Costs, *Model studies, Biodegradation, Chemical treatment, Filtration, Aerobic treatment, Anaerobic digestion, Ammonium, Phosphates, Metals, Bacteria, Military reservations, In situ tests, Performance evaluation.

In situ biodegradation is enhanced by stimulating the indigenous subsurface microbial population by the addition of nutrients and an oxygen source to promote degradation of organic contaminants. In situ treatment affects contaminants sorbed to soil as well as dissolved in groundwater. It is potentially faster, and therefore cheaper, than conventional pump-and-treat technologies. The test site was contaminated with a mixture of organic and inorganic chemicals. The treatment system consisted of an array of nine pumping wells and four infiltration wells. These wells circulated groundwater and transported the treatment chemicals throughout the 2800 sq ft treatment area. Oxygen was supplied by means of a hydrogen peroxide solution. Nutrients were principally ammonium and phosphate salts. The system was operated for 9 months. Data showed evidence of both aerobic and anaerobic biodegradation. Decreases in tetrachloroethylene and trichloroethylene concentrations in groundwater correlate with anaerobic microcosm tests. Calcium phosphate precipitation clogged infiltration wells and reduced the infiltration capacity of the test area by 90%. Metal sediments, primarily iron compounds, were found in the treatment

system plumbing. These metals were probably mobilized by chemical reactions resulting from injecting high concentrations of hydrogen peroxide and nutrients, and may have been transported as small particles. The costs of the in situ treatment test were closely monitored. The technology was found to be no more expensive than conventional technologies. The study confirms that indigenous bacteria can be enhanced to degrade organic contaminants. The problems with in situ treatment are primarily those of delivery of chemicals and minimizing adverse reactions between injection chemicals and subsurface minerals. (Lantz-PTT)
W89-08538

SUPERFUND ENFORCEMENT DECISION DOCUMENT: LITCHFIELD AIRPORT/PHOENIX, AZ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161 as PB88-220413. Price codes: A04 in paper copy, A01 in microfiche. Report No. EOA/ROD/R09-87/0012, September 1987. 50p, 7 fig, 9 tab, 2 append.

Descriptors: *Water pollution treatment, *Organic compounds, *Superfund, *Groundwater pollution, *Water pollution sources, *Cleanup operations, *Arizona, Airports, Phoenix, Volatile organic compounds, Chromium, Trichloroethylene, Air stripping, Costs, Granular activated carbon.

The Litchfield/Phoenix-Goodyear Airport (PGA) site covers a total area of approximately 35 sq mi and is located 17 miles west of Phoenix, Arizona. The site is divided into a northern and a southern area by a groundwater divide running under the Yuma Road area. Section 16 (about 17 acres) lies in the southern area and includes the Loral Corporation facility (formerly owned by Goodyear Aerospace Corp.) and the Phoenix-Goodyear Airport (formerly owned by U.S. Navy), both being potential sources of volatile organic compound (VOC) contamination. Groundwater contaminant concentrations in Section 16 are at least 100 times greater than down gradient levels. Development by the City of Goodyear is planned for the area west, or downgradient, of Section 16. This development will include using the groundwater resources currently threatened by contamination in Section 16. In 1981, the Arizona Dept. of Health Services discovered solvent and chromium contamination in the groundwater within the PGA area. Additional sampling in 1982 and 1983 found 18 wells contaminated with TCE. The primary contaminants of concern include: TCE, VOCs and chromium. The selected interim remedial action for this site includes: groundwater pump and treatment from the Subunit A aquifer of the entire Section 16 area by air stripping with reinjection of the stripped water back into the Subunit A aquifer; and Loral Corporation and PGA will continue to pump groundwater from Subunit B/C and treat with granular activated carbon. The estimated present worth cost for this selected remedy is $2,358,500 with operation and maintenance of $800,200. (Author's abstract)
W89-08539

SUPERFUND RECORD OF DECISION: GOLD COAST, FL.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-220959. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-87/028, September 1987. 75p, 7 fig, 14 tab.

Descriptors: *Water pollution treatment, *Path of pollutants, *Chemical wastes, *Soil contamination, *Groundwater pollution, *Superfund, *Cleanup operations, *Florida, Heavy metals, Lead, Volatile organic compounds, Trichloroethylene, Waste disposal, Organic compounds, Solidification, Recharge, Costs.

The Gold Coast Oil Corporation (GCO) site is located in Miami, Florida. The two-acre site is within a commercial/industrial/residential area and located over the Biscayne Aquifer, the sole source aquifer for the area. Groundwater is used for drinking water, irrigation and industrial purposes. The site property is owned by Seaboard System Railroad Company, currently known as CSX Transportation, who leased the property to GCO in the early 1970s. GCO, along with Solvent Extraction, Inc., were in the business of distilling mineral spirits, lacquer thinner and reclaiming solvents. Blowdown from these operations was sprayed directly onto the ground and 53 drums of sludge-contaminated soil were stored onsite. Still-bottom waste from the distilling operation was pumped into a tank truck for storage. Additionally, 2,500 corroded and leaking drums containing sludge from the distilling operation, contaminated soils, paint sludges and large storage tanks of hazardous waste were located onsite. All wastes generated by the solvent recovery operations were disposed or stored onsite. In 1982, CSX Transportation evicted GCO from the property and agreed to voluntarily clean up the site. The cleanup involved removing the drums, emptying storage tanks and excavating and removing contaminated soil to a depth of approximately six inches. Soil and groundwater are contaminated with TCE, PCE, and other VOCs, lead and other heavy metals. The selected remedial action for this site includes: excavation of approximately 500 cu yd of contaminated soil and hardened waste sludges with offsite disposal at a RCRA-approved facility; stabilization/solidification and onsite placement with capping contaminated groundwater by means of a recovery well field; groundwater treatment with disposal, including recharge to the aquifer, discharge to the publicly-owned treatment works or discharge to surface waters (both treatment and disposal options will be determined during design); removal and disposal of storage tanks, concrete block office, supply shed, two abandoned automobiles, an aircraft engine, the concrete slabs and storage saddles; and testing and decommissioning of the onsite supply well. The estimated total cost for this remedial action is $3,711,600 with present worth operation and maintenance of $74,850. (Author's abstract)
W89-08541

APPLICATIONS OF MECHANICAL PUMPS AND MIXERS TO IMPROVE WATER QUALITY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. E. Price.
Water Operations Technical Support Information Exchange Bulletin, Vol E-88-3, December 1988. 4p, 3 fig, 8 ref.

Descriptors: *Hydraulic machinery, *Pumps, *Mixers, *Water quality control, Thermal stratification, Water quality, Hydraulic equipment, Lake restoration, Destratification.

Thermal stratification occurring at Corps of Engineers projects may create water quality problems in the hypolimnion. Of the techniques currently available to alleviate these problems, those using mechanical pumps appear particularly promising in light of their immediate availability and simplicity of design and operation. The low-energy axial flow design has been proven effective in lake destratification applications and, along with direct-drive mixers, applicable to localized mixing applications. The aspirating mixer is particularly suited to shallow small areas requiring aeration such as stilling basins and harbors. (Lantz-PTT)
W89-08543

AMBIENT WATER QUALITY CRITERIA FOR SELENIUM-1987.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-142237. Price codes: A06 in paper copy, A01 in microfiche. September 1987. 121p, 6 tab, 231 ref.

Descriptors: *Water quality standards, *Literature review, *Toxicity, *Bioassay, *Water pollution effects, *Selenium, *Aquatic environment, Trout, Fathead minnows, Fish, Algae, Bass, Invertebrates, Standards.

Acute values of selenium (IV) for 23 freshwater fish and invertebrate species in 22 genera range from 340 micrograms/L microg/L for the amphipod, Hyalcila azteca, to 203,000 micro/L for the leech Nephelopsis obscura. Although twelve of the twenty-three species are fish, both the two most sensitive and the two most resistant species are invertebrates. Chronic values are available for two fish and two invertebrates and range from > 47 to 692 microg/L. Toxicity values for nine species of freshwater algae range from 500 to 30,000 microg/L. Uptake of Se(IV) by fish takes about 100 days to reach steady-state and bioconcentration factors from 2 to 452 have been reported. Acute toxicity values are available for 16 species of saltwater animals, including 8 invertebrates and 8 fish, and range from 599 microg/L for larvae of the haddock. Melanogrammus aeglefinus, to 17,350 microg/L for adults of the fourspine stickleback, Apeltes quadracus. Chronic toxicity data are available for two saltwater animals, the mysid, Mysidopsis bahia, and the sheepshead minnow, Cyprinodon variegatus. The chronic values and the acute-chronic ratios are 211.7 and 7.085 for the mysid, and 675.2 microg/L and 10.96 for the sheepshead minnow. The acute toxicity of Se(VI) has been determined with twelve freshwater animal species. The acute values range from 75 microg/L with the amphipod, Gammarus pseudolimnaeus, to 442,000 with the leech, Nephelopsis obscura. Chronic toxicity tests have been conducted with Daphnia magna, the fathead minnow, and the rainbow trout. The chronic values range from 565.5 to 1,999 microg/L, and the acute-chronic ratios range from 2.651 to 16.26. Se(VI) affected nine algal species at concentrations ranging from 10 to 39,000 microg/L. Bioaccumulation factors obtained with the fathead minnow ranged from 21 to 52 microg/L. Other data present results pertaining to saltwater species and a variety of waterfowl and animals along the food chains. How the results fit into the National standards is discussed at length. (Lantz-PTT)
W89-08546

INTERIM PROTOCOL FOR MEASURING HYDROLYSIS RATE CONSTANTS IN AQUEOUS SOLUTIONS,
Environmental Research Lab., Athens, GA.
J. J. Ellington, F. E. Stancil, W. D. Payne, and C. D. Trusty.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-225081. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/014, June 1988. 53p, 1 fig, 5 tab, 8 ref, 10 append.

Descriptors: *Fate of pollutants, *Water analysis, *Mathematical models, *Water quality standards, *Hydrolysis, Chemical properties, Chemical analysis, Chemical reactions, Rate constants, Aqueous solutions.

As environmental controls become more expensive and penalties for judgement errors become more severe, environmental management requires more precise assessment tools based on greater knowledge of relevant phenomena. Mathematical models are widely used in predicting the fate of organic chemicals in lakes and streams and in soil systems. Application of these models requires as input the second-order and first-order hydrolysis rate constants for chemicals containing hydrolyzable functional groups. A detailed protocol was developed to measure these constants for organic chemicals for use in models for predicting persistence in aquatic systems. The protocol delineates theoretical considerations, laboratory experiments, and calculation procedures. Repetitive application of the protocol to measure hydrolysis rate constants for four standard reference compounds over a period of 2 years yielded coefficients of variation of < 12% in the measurements. (Author's abstract)
W89-08550

SUPERFUND RECORD OF DECISION: SAN GABRIEL, CA.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information

Service, Springfield, VA 22161, as PB88-220926. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R09-87/015, September 1987. 70p, 4 tab, 11 ref, append.

Descriptors: *Path of pollutants, *Water pollution control, *Water quality control, *California, *Groundwater pollution, *Water pollution treatment, *Superfund, *Chlorinated hydrocarbons, *Cleanup operations, San Gabriel, Water pollution sources, Trichloroethylene, Costs, Adsorption, Activated carbon, Monitoring.

San Gabriel Area 1, of the San Gabriel Ground Water Basin, is located primarily underneath the city of El Monte, Los Angeles County, California. In 1980, the State of California, in an extensive well water testing program in the San Gabriel basin, found numerous wells contaminated with TCE, PCE and other chlorinated hydrocarbons. As a result, the California Department of Health Services (DOHS) directed area public water companies to implement periodic well testing. State Action Levels for TCE and PCE were set at five and four ppb (parts per billion), respectively. If alternative methods of reducing TCE and PCE concentrations below the Action Levels were not effective, wells would be removed from service. In 1983, when EPA became involved in addressing the problem, three mutual water companies, Richwood, Rurban Homes and Hemlock, had no alternate water supply and had been providing their customers with PCE contaminated water above the DOHS Action Level. In May 1984, EPA Region IX's Regional Administrator signed a Record of Decision (ROD) selecting air stripping treatment as the most cost-effective initial remedial measure (IRM) to provide the three mutual water companies in El Monte with a source of uncontaminated water. During the design phase of the IRM, it became apparent that the cost to construct and operate air stripping systems would be much higher than estimated in the Focused Feasibility Study and the ROD due to the severe site constraints associated with these systems. As a result, revised cost estimates have been developed for all of the ROD's alternatives. Based on these revised costs and other factors, EPA has determined that carbon adsorption treatment is now the cost-effective alternative to treat the PCE contaminated groundwater. The selected interim remedial action for this site includes: installation of an activated carbon adsorption system for treatment of well discharge at the Richwood Mutual Water Company; completion of the design and development of bid documents for the Rurban Homes system, monitoring of this system with implementation of a carbon adsorption system if monitoring results show an increase in well contaminant levels; and based on future determinations, if necessary, an upgrade to the Hemlock system. The estimated capital cost for the selected remedy is $1,616,100-$1,771,800 with annual operation and maintenance of $181,400-$303,100. (Author's abstract)
W89-08552

BENEFICIAL USES OF DREDGED MATERIAL IN SEVEN NEW ENGLAND PROJECTS,
Baystate Environmental Consultants, Inc., East Longmeadow, MA.
J. E. Walsh, C. Carranza, and R. G. Humphrey.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 177-183, 2 tab.

Descriptors: *Massachusetts, *Water quality control, *Spoil disposal, *Beneficial use, *Lake restoration, *Eutrophic lakes, *Dredging, *Water resources development, *Case studies, Bantam Lake, 1860 Reservoir, Gorton Pond, Nutting Lake, Willow Lake, Dunn's Pond, Porter Lake, Waste disposal, Connecticut, Ecological effects.

Dredging is becoming increasingly utilized as a method for restoring eutrophic lakes in New England. Dredging has been shown to improve water quality, reduce aquatic macrophyte growth, and restore lost recreational amenities by physically deepening the lake, as well as by removing oxygen demanding, nutrient-rich organic bottom materials. The number of actual dredging projects being carried out has increased over the past few years due to active funding programs which have been instituted in individual states. This paper examines the ultimate dredged material uses for seven projects in New England in which dredging is being utilized as a lake-restoration technique. The type of dredge used is discussed along with the overall characteristics of the dredged material and the design removal volumes for each project. All seven projects utilize confined upland disposal sites. The ultimate disposal use of the dredged material along with its impact on project costs to data is summarized for each project. The seven projects are located in Connecticut or Massachusetts. The three projects in Connecticut include: (1) Bantam Lake at Morris and Litchfield, dredged from 1978 to the present; (2) 1860 Reservoir at Wethersfield, dredged from 1984 to the present; and (3) Gorton Pond at East Lyme, dredged in 1984. The four projects located in Massachusetts include: (1) Nutting Lake at Billerica, dredged from 1978 to 1985; (2) Dunn's Pond at Gardner, dredged in 1983 and 1984; (3) Willow Lake at Northampton, dredged in 1985 and 1986; and (4) Porter Lake at Springfield, scheduled to be dredged in 1988 and 1989. Four of the seven projects are partially funded by the EPA through their Clean Lakes Program. All seven of these projects are partially financed by State and local agencies. (See also W89-08555) (Lantz-PTT)
W89-08565

BENEFICIAL USES FROM DREDGED LAKE SEDIMENTS IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W89-08566

GEOHYDROLOGY OF THE WELLINGTON-ALLUVIAL AQUIFER SYSTEM AND EVALUATION OF POSSIBLE LOCATIONS OF RELIEF WELLS TO DECREASE SALINE GROUNDWATER DISCHARGE TO THE SMOKY HILL AND SOLOMON RIVERS, CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08651

HYDROLOGIC DATA FROM THE JOHNSON BROOK PHOSPHORUS LOADING STUDY, KENNEBEC COUNTY, MAINE, MARCH 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
T. J. Maloney, D. R. Dominic, and W. J. Nichols.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-143, March 1983. 24p, 1 fig, 3 tab, 9 ref.

Descriptors: *Maine, *Agricultural runoff, *Hydrologic data collections, *Phosphorus, *Water quality, Streamflow, Precipitation, Seasonal variation, Suspended sediments, Water temperature, Specific conductivity, Data collections.

Streamflow, water quality, and precipitation data collected during the 1980 and 1981 water years are reported. The purpose was to document changes in total phosphorus loads resulting from a change in agricultural waste management practices in the Johnson Brook watershed in Maine. Streamflow data include mean-daily discharges for the period May 12, 1980, through September 30, 1981, and instantaneous discharges determined during water quality sampling. Water quality data for the period March 1980 to September 1981 include total phosphorus concentrations determined from samples collected using cross-sectional depth-integrating sampling techniques and from samples collected using a pumping sampler. Suspended sediment concentrations, and water temperature and specific conductance values are also included. The precipitation data are daily totals for the period October 1980 through September 1981. (Lantz-PTT)
W89-08656

SUPERFUND RECORD OF DECISION: MONTGOMERY TOWNSHIP, NJ.
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-159942. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-87/045, September 1987. 117p, 9 fig, 6 tab, 6 append.

Descriptors: *Groundwater pollution, *Water pollution control, *Water quality control, *Cleanup operations, *Superfund, *Path of pollutants, *New Jersey, *Trichloroethylene, Volatile organic compounds, Organic compounds, Costs.

The Montgomery Township Housing Development (MTHD) is a 72-acre tract of land located in Somerset County, New Jersey. The housing development consists of 71 home sites. The original potable water source for each home was a private well drawing from the underlying aquifer. In 1978, the Borough of Rocky Hill, which is located near the site, sampled groundwater from the Borough well and found it to be contaminated with trichloroethylene (TCE). Testing continued through 1983, and repeated evidence of TCE contamination prompted the New Jersey Department of Environmental Protection to sample the MTHD well. Results indicated the presence of TCE and other volatile organics in that and other surrounding wells. In 1981, 20 homes in the MTHD were connected to the Elizabethtown Water company water mains. To date, 38 residences have hooked up. Due to the similarity of contaminants and the proximity of the MTHD and Rocky Hill Municipal Well Superfund sites, a combined remedial investigation/feasibility study is being performed. This record of decision (ROD) focuses only on an alternate water supply for MTHD. The primary contaminant of concern is TCE, with secondary contaminants being other volatile organics. The selected first operable unit remedial action is to extend the Elizabethtown Water Company distribution system to currently or potentially affected residents of MTHD. The estimated capital cost of this alternative is $319,000, with no annual operation and maintenance. (Author's abstract)
W89-08696

PROTECTION OF PUBLIC WATER SUPPLIES FROM GROUND-WATER CONTAMINATION.
Noyes Data Corporation, Park Ridge, New Jersey.
1987. 177p.

Descriptors: *Drinking water, *Water supply, *Groundwater management, *Water pollution control, *Water quality control, *Groundwater pollution, *Water pollution prevention, *Groundwater quality, Surface-groundwater relations, Potable water, Water management, Geohydrology, Water supply development, Decontamination, Cost-benefit analysis, Management planning.

This publication provides an organized approach to acquiring the knowledge necessary for effective and efficient protection of the quality of groundwater supplies, through discussions of: (1) basic groundwater hydrology; (2) classification of groundwater regions; (3) groundwater-surface water relationships; (4) groundwater pollution; (5) management alternatives; (6) control of volatile organic compounds in groundwater used for drinking; and (7) inground treatment, restoration, and reclamation. The development of subsurface water supplies has little effect on land use and can usually be accomplished at relatively low cost compared to the development of surface supplies. However, the subsurface environment is a complex system subject to contamination from a host of sources. Because of the protracted effects of contamination and problems of accessibility, the restoration of groundwater quality is difficult and expensive. Restoration costs generally exceed the short-term value of the resource when compared to the costs of alternatives. The most promising management option now available is to protect the groundwater resource from contamination. (Lantz-PTT)
W89-08697

MANAGEMENT OF ORGANIC RESIDUALS SEPARATED FROM INDUSTRIAL WASTES,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
For primary bibliographic entry see Field 5D.
W89-08715

EFFECTS OF WETLANDS ON QUALITY OF RUNOFF ENTERING LAKES IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
R. G. Brown.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4170, 1985. 32p, 11 fig, 2 tab, 43 ref.

Descriptors: *Wetlands, *Runoff, *Water quality, *Lakes, *Urban areas, *Water quality control, *Water pollution control, *Minnesota, Nutrients, Suspended solids, Cattails, Drainage, Sedimentation.

Four wetlands were compared with respect to their effectiveness in decreasing suspended solids and nutrient concentrations in runoff to lakes immediately downstream from the wetlands. An artificial impoundment in one of the wetlands increased settling of suspended solids. A decrease of nutrients in this wetland was probably the result of high assimilation rates associated with a dense stand of cattails. Two of the other three wetlands consist of open water and land areas, both of which contain abundant vegetation. Drainage from land areas within the wetlands may have lowered the overall effectiveness of the wetlands in decreasing sediment and nutrient concentrations. The third wetland was a constructed wetland that was ineffective in decreasing sediment or nutrient concentrations because its storage capacity was too small to prevent frequent flushing of accumulated sediment. Sediment concentrations in discharge from this wetland were as much as 22 times greater than the already high sediment concentrations in the inflow. (Author's abstract)
W89-08749

STATISTICAL SUMMARY AND EVALUATION OF THE QUALITY OF SURFACE WATER IN THE COLORADO RIVER BASIN, 1973-82 WATER YEARS,
Geological Survey, Austin, TX. Water Resources Div.
F. L. Andrews, and T. L. Schertz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4181, 1986. 97p, 14 fig, 18 tab, 23 ref.

Descriptors: *Water quality, *Water pollution, *Colorado River, *Water quality, *Statistical analysis, River basins, Dissolved solids, Sodium, Chlorides, Calcium, Bicarbonates, Nutrients, Nitrates, Nitrogen, Coliforms, Bacteria, Biochemical oxygen demand, Pesticides, Trace elements.

Significant upward trends in dissolved solids concentrations were detected with the Seasonal Kendall Test for trends at three stations in the upper basin during the study period. The increases exceeded 270 mg/L/yr at two stations and 165 mg/L/yr at the third station. The composition of dissolved constituents in the Colorado River basin changes from predominantly sodium and chloride ions in the upper basin to predominantly calcium and bicarbonate ions in the lower basin. The U.S. EPA secondary drinking water regulations of 500 mg/L for total dissolved solids was exceeded 95% of the time at each station on the main stem of the Colorado River in the upper basin. In the middle Colorado River basin, the EPA secondary drinking water regulations for total dissolved solids was exceeded approximately 95% of the time at most stations. Nutrient concentrations in the Colorado River basin generally were low. Only one sample exceeded the level set for nitrate nitrogen, and no other nutrient species exceeded EPA levels. A general upward trend was detected in organic nitrogen and total nitrogen, but concentrations still remained low. Densities of fecal coliform and fecal streptococcal bacteria ranged less than 1 colony/100 ml to 26,000 colonies/100 ml and 1 colony/100 ml to 50,000 colonies/100 ml, respectively. Fecal coliform densities exceeded EPA criteria for public water supply (2,000 colonies/100 ml) at several stations during the study. Biochemical oxygen demand concentrations ranged from 0.00 to 34 mg/L. Only one mean biochemical oxygen demand concentration exceeded 8 mg/L, the upper range of concentration common in moderately contaminated streams. Trace elements and pesticides were detected in many samples throughout the basin. The concentrations generally were low, and maximum contaminant levels rarely were exceeded. (Author's abstract)
W89-08806

HYDROGEOLOGY, WATER QUALITY, AND GROUND-WATER DEVELOPMENT ALTERNATIVES IN THE BEAVER-PASQUISET GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08812

EVALUATION OF THE EFFECTS OF COAL-MINE RECLAMATION ON WATER QUALITY IN BIG FOUR HOLLOW NEAR LAKE HOPE, SOUTHEASTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
V. E. Nichols.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4197, 1985. 215p, 17 fig, 22 tab, 15 ref.

Descriptors: *Water pollution prevention, *Cleanup operations, *Coal mining, *Ecological effects, *Land reclamation, *Ohio, *Acid mine drainage, Lake Hope, Big Four Hollow Creek, Hydrogen ion concentration, Sulfates, Iron, Specific conductivity, Manganese, Water pollution sources.

A subsurface clay dike and mine entrance hydraulic seals were constructed from July 1979 through May 1980 by the Ohio Department of Natural Resources, Division of Reclamation, to reduce acidic mine drainage from abandoned drift-mine complex 88 into Big Four Hollow Creek. Big Four Hollow Creek flows into Sandy Run--the major tributary to Lake Hope. A data collection program was established in 1979 by the U.S. Geological Survey to evaluate effects of drift-mine sealing on surface water and groundwater systems of the Big Four Hollow Creek and Sandy Run area just below the mine. Data collected show that pH ranged from 2.7 to 4.8, with a median of 3.1. The calculated sulfate load was 1,200 lb/day, and the calculated iron load was 50 lb/day. Data collected near the mouth of Big Four Hollow Creek (station 03201700) from 1971 through 1979 (before dike construction) show the daily pH ranged from 2.1 to 6.7; the median was 3.6. The daily specific conductance ranged from 72 to 3,500 microsiemens/cm at 25 C and averaged 770. The estimated loads of chemical constituents were: Sulfate, 1,100 lb/day; iron, 54 lb/day; and manganese, 12 lb/day. All postconstruction data collected at station 03201700 through the end of the project, May 1980 through June 30, 1983, show that the daily pH ranged from 2.4 to 7.7, with a median of 3.7. Daily specific conductance ranged from 87 to 3,200 microsiemens/cm and averaged 1,200. The estimated loads of chemical constituents for this period were: Sulfate, 1,000 lb/day; iron, 44 lb/day; and manganese, 16 lb/day. Standard nonparametric statistical tests were performed on the data collected before and after reclamation. Differences at the 95% confidence level were found in the before- and after-reclamation data sets for specific conductance, aluminum, and manganese at station 03201700. Data collected during the first 6 months after reclamation indicated moderate improvement in water quality only because no highly mineralized water was leaking from the closed mine. Later, perhaps in September 1980, increased hydraulic head behind the clay dike caused the mine water to seep out and degrade the stream water quality. (Author's abstract)
W89-08820

EFFECTS OF SURFACE COAL MINING AND RECLAMATION ON GROUND WATER IN SMALL WATERSHEDS IN THE ALLEGHENY PLATEAU, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
M. Eberle, and A. C. Razem.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4205, 1985. 13p, 6 fig, 2 tab, 20 ref.

Descriptors: *Land reclamation, *Small watersheds, *Water pollution control, *Coal mining, *Groundwater pollution, *Ohio, *Ecological effects, Aquifers, Geohydrology, Aquifers, Groundwater quality, Groundwater level, Leakage, Calcium sulfate, Calcium bicarbonate, Specific conductivity, Prediction.

The hydrologic effects of surface coal mining in unmined areas is difficult to predict, partly because of a lack of adequate data collected before and after mining and reclamation. In order to help provide data to assess the effects of surface mining on the hydrology of small basins in the coal fields of the eastern United States, the U.S. Bureau of Mines sponsored a comprehensive hydrologic study at three sites in the Ohio part of the Eastern Coal Province. These sites are within the unglaciated part of the Allegheny Plateau, and are representative of similar coal-producing areas in Kentucky, West Virginia, and Pennsylvania. The U.S. Geological Survey was responsible for the groundwater phase of the study. The aquifer system at each watershed consisted of two localized perched aquifers (top and middle) above a deeper, more regional aquifer. The pre-mining top aquifer was destroyed by mining in each case, and was replaced by spoils during reclamation. The spoils formed new top aquifers that were slowly becoming resaturated at the end of the study period. Water levels in the middle aquifers were about the same after reclamation as before mining, although levels rose in a few places. It appears that the underclay at the base of the new top aquifers at all three sites prevents significant downward leakage from the top aquifer to lower aquifers except in places where the layer may have been damaged during mining. Water in the new top aquifers is a calcium sulfate type, whereas calcium bicarbonate type water predominated before mining. The median specific conductance of water in the new top aquifers was about 5 times > that of the original top aquifers in two of the watersheds, and 1-1/2 times the level of the original top aquifer in the third. Concentrations of dissolved sulfate, iron, and manganese in the top aquifers before mining generally did not exceed U.S. and Ohio EPA drinking water limits, but generally exceeded these limits after reclamation. Water quality changes in the middle aquifers were minor by comparison. Water levels and water quality in the deeper, regional aquifers were unaffected by mining. (Author's abstract)
W89-08825

REGIONAL WATER RESOURCES SITUATION: QUANTITATIVE AND QUALITATIVE ASPECTS,
Environmental Coordinating Unit, ESCAP, Bangkok, Thailand.
K. F. Jalal.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 13-34, 9 tab, 4 ref.

Descriptors: *Water supply, *Water quality, *Regional development, *Asia, *Water resources development, *Water management, *Water policy, Planning, Water pollution, Southeast Asia, International waters, Competing use.

An important aspect of water resources development is the effort to integrate water systems that transcend national boundaries. The complex socio-

political problems are further exacerbated by real and perceived questions of adequate supply, conflicting projects, and competing demands of shared river systems. This paper provides a broad overview of the water resources situation in Southeast Asia. Beginning with a description of both regional and national water resources development and management efforts, an attempt is made to provide the context of policy principles, institutional concerns, and operational guidelines. Included in the discussion are freshwater and marine resources, the problems of aquatic pollution and efforts for its control, with an emphasis placed on the need for resources planning and the implementation of a national water policy. (Sand-PTT)
W89-08900

WATER RESOURCES DEVELOPMENT IN CHINA,
Ministry of Water Resources and Electric Power, Beijing (China).
For primary bibliographic entry see Field 6E.
W89-08902

WATER RESOURCES DEVELOPMENT IN THE PHILIPPINES,
National Irrigation Administration, Quezon City (Philipines).
For primary bibliographic entry see Field 6E.
W89-08908

WATER QUALITY POLICIES AND LAWS: INTEGRATED CONTROL,
Washington Univ., Seattle. School of Law.
R. W. Johnson.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 335-348.

Descriptors: *Administrative regulations, *Effluent charges, *Water pollution control, *Water quality, *Water policy, *Water law, Legal aspects, Political aspects, Economic efficiency.

This paper discusses the two most widely used policy approaches to pollution control: the regulatory system and the effluent charge system. Under the regulatory system, laws, regulations, and orders are issued by the government establishing a water pollution control program. Orders are issued to municipalities and industries to control the amount and location of wastes discharged into public waters. This system depends on the legal and political authority of government to impose regulations and orders on waste dischargers. Under the effluent charge system, charges are levied on municipalities and industries for the privilege of depositing wastes into public waters. The charges are not nominal, but are set high enough to create realistic economic incentives for waste dischargers to find alternative means of production that create less waste, or to find and install more efficient waste clean-up processes. The need for comprehensiveness in pollution control systems, i.e. one that covers all private and government dischargers of waste, is stressed. Also discussed is the concept of allowing free market trading of waste discharge opportunities toward the goal of achieving economic efficiency. This system is now being considered in some countries as a supplement to both the regulatory and effluent charge systems. (See also W89-08899) (Sand-PTT)
W89-08919

WATER QUALITY: PROBLEMS AND NEEDS FOR INTEGRATED CONTROL IN BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
A. Nishat, and S. K. Chowdhury.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 349-362, 3 fig, 1 tab, 10 ref.

Descriptors: *Water quality, *Water quality control, *Rivers, *Saline water intrusion, *Estuaries, *Water pollution, *Bangladesh, *Developing countries, Water resources development, Ecosystems, Mathematical models, Brahmaputra River, Ganges River, Saline-freshwater interfaces, Industrial wastes, Urbanization.

One of the major considerations for determining the volume of water that may be utilized for irrigation in Bangladesh is the requirement of freshwater flow in the Meghna estuary for maintaining the salinity within acceptable limits. Although the present level of abstraction of water from the river networks of Bangladesh does not seriously induce the problem of salinity intrusion in the Meghna estuary, the southeastern region is seriously suffering from saline intrusion in the dry months. Studies have demonstrated that an ensured flow of 5000 cfs in the Gorai-Madhumati system in the critical months will control the salinity, and engineering measures should be taken to provide this freshwater supply. For planning of water development in the Ganges, the Brahmaputra, and the Meghna rivers, the limiting condition will be the maximum diversion that may be made without resulting in a saline intrusion in the Meghna estuary. A pilot mathematical model has been set up to study the phenomenon, which needs further improvement. The interrelationship between fresh and saline water interface in the coastal area is discussed. The interface is well defined, and this sharp boundary is sensitive to the availability of fresh recharge water. The problems of urban and industrial pollution are gradually increasing. Untreated or partially treated effluents are seriously affecting the quality of river water. The present rapid growth rate of the cities and townships will pose a major problem for domestic water supply in the near future. As a result, it is important that the water quality aspect should be integrated with the overall water resources of the country. (See also W89-08899) (Sand-PTT)
W89-08920

PLUMBING MATERIALS AND DRINKING WATER QUALITY,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
T. J. Sorg, and F. A. Bell.
Noyes Publications, Park Ridge, New Jersey. 1986. 182p.

Descriptors: *Plumbing, *Drinking water, *Water quality, *Pipes, Pipelines, Conferences, Conveyance structures, Regulations.

On May 16-17, 1984, the Office of Drinking Water and the Drinking Water Research Division of the U.S. EPA cosponsored a seminar to review drinking water problems related to plumbing materials (including those used in service lines) and to identify solutions for dealing with these problems. During the first day, speakers addressed three general topics: (1) the use, application, and availability of plumbing materials (metallic and plastic); (2) the impact of these materials on water quality; and (3) solutions to plumbing problems related to water quality. On the second day, four concurrent panel sessions were held on these four panel topics: (1) joining alternatives for copper pipe; (2) metal pipe and fitting alternatives for plumbing; (3) plastic pipe and fittings; and (4) regulatory and compliance aspects. The first section of these Proceedings (Parts I-IV) includes the papers given by the speakers on plumbing material applications, problems, and solutions. The second section (Part V) contains the reports of the panel sessions prepared by the panel chairmen. The Proceedings conclude with a summary (Part VI) of the conclusions and recommendations of the panel meetings and a synopsis of the seminar presentations. (See W89-08968 thru W89-08977) (Lantz-PTT)
W89-08967

PLASTIC PIPING AND JOINING MATERIALS,
Plastics Pipe Inst., New York.
S. A. Mruk.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 10-26, 7 tab.

Descriptors: *Plumbing, *Pipes, *Pipelines, *Plastics, Conveyance structures, Polyethylene, Polybutylene, Polyvinyl chloride, Chlorinated polyvinyl chloride, Acrylonitrile-butadiene-styrene, Water quality, Drinking water, Standards.

Since the 1950s, thermoplastics piping has become a widely used material for a broad range of applications including water distribution, industrial uses, and power and communications ducting. Experience has established that thermoplastics piping very often provides the most economical and satisfactory long-term solution. The broad acceptance of thermoplastics piping not only evidences the inherent capabilities and versatility of these materials, but also reflects the attention that has been given to the development of a standardization system that suitably addresses all the major performance requirements, including preservation of water quality. The key element of the standardization system covering thermoplastics piping for potable water applications is that it scrutinizes characteristics: no adverse effect to water quality, and long-term strength under end-use conditions. Plastics used for potable water transport include: polyvinyl chloride, chlorinated polyvinyl chloride, polyethylene, polybutylene, and acrylonitrile-butadiene-styrene. Advantages of these materials are: immunity to 'corrosion', nonconductivity of electricity, light weight, ease of use, hydraulically smooth surfaces, elimination of brazing and soldering, low stiffness, ductility, durability, and energy efficiency. Limitations to plastic piping include: time, temperature and environment sensitivity; high coefficient of expansion/contraction; light weight; electrical insulator; and combustability. (See also W89-08967) (Lantz-PTT)
W89-08969

DRINKING WATER REGULATIONS AND THEIR IMPACT ON MATERIALS USED IN WATER SYSTEMS,
Oregon State Health Div., Portland. Drinking Water Program.
J. R. Boydston.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 107-112, 9 ref.

Descriptors: *Plumbing, *Conveyance structures, *Drinking water, *Regulations, *Pipelines, *Water quality control, Metals, Water sampling, Corrosion, Federal jurisdiction, Standards, State jurisdiction, Water conveyance.

Regulations and plumbing code requirements have a very definite influence on the materials used in water systems and house plumbing. One of the problems of greatest current concern is the presence of heavy metals in drinking water resulting from lead or other piping materials being used to convey waters that are highly corrosive. A number of regulations have been developed at both federal and state levels in an attempt to prevent health hazards. The U.S. EPA is currently in the process of adopting national revised primary drinking water regulations. The current interim regulations specify maximum contaminant levels for microbiological, inorganic, and organic chemicals and radionuclides. The maximum contaminant level (MCL) means 'the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system.' These MCLs are currently being reviewed and in a number of instances may be significantly lowered. In addition to the MCLs, the interim regulations also include requirements to identify the presence of specific materials in distribution systems and to monitor for corrosivity. EPA has also developed Water Supply Guidance Number 73 on sampling techniques to be used for compliance monitoring for metals in drinking water. These sampling techniques are not federally enforceable but are intended to provide a standardized method for testing for corrosion by-products. This guidance provides for collection of three samples: from a house faucet to represent the water that has been standing overnight in the house plumbing, from the service line to the house, and from the distribution system. In addition to federal and state drinking water regulations, plumbing code requirements also influence materials used in house plumbing systems. The plumbing codes of most states are based upon some national model such as the Uniform Plumbing Code. (See also W89-08967) (Lantz-PTT)
W89-08976

DEGRADATION OF HAZARDOUS ORGANIC WASTES BY MICROORGANISMS,
Naval Ocean Systems Center, San Diego, CA.
P. Kenis.
Available from the National Technical Information Service, Springfield, VA 22161, as AD/A196 671. Price codes: A04 in paper copy, A01 in microfiche. May 1988. 78p, 2 tab, 16 ref.

Descriptors: *In situ treatment, *Cleanup, *Water pollution treatment, *Biodegradation, *Hazardous wastes, *Organic compounds, Microbial degradation, Microbiological studies, Oxygen, Nitrogen, Phosphorus, Biological studies, Groundwater, Soil contamination.

The detoxification of hazardous organic compounds before and after they have contaminated soil, groundwater, ponds, and other areas was investigated. In situ degradation of hazardous organic materials by microbes is often the most cost-effective cleanup approach. In addition, on-site treatment has the advantage of minimizing the potential legal liability associated with transportation and the potential continuing liability even when the hazardous material is at a disposal site. The degradation (detoxification) of most hazardous organic materials occurs best under aerobic conditions by bacterial oxidative processes. The toxic organic compound serves as the energy or carbon source for bacterial metabolism and multiplication, with oxygen as the final electron acceptor. The ultimate degradation products from bacterial oxidation are water and carbon dioxide. Microorganisms capable of degrading many hydrocarbons, simple aromatic compounds, and other organics occur naturally in soils and groundwater. Natural degradation occurs very slowly, however, because oxygen and nutrients are lacking. By adding oxygen, nitrogen, phosphorus, and trace nutrients, the microbes can be stimulated to use the organic contaminant as a carbon and energy source. Companies which use biological processes to clean up hazardous wastes may do so by any one or any combination of the following methods: (1) by adding nutrients and oxygen to stimulate natural microbial populations for in situ biodegradation; (2) by adding specialty cultures which have been selected or mutated to degrade the hazardous material of interest more effectively; and (3) by using permanent or portable treatment plants that employ microbes to degrade hazardous organics. (Lantz-PTT)
W89-09047

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT:CASE STUDIES ON GROUNDWATER AND SURFACE WATER CONTAMINATION FROM MUNICIPAL SOLID WASTE LANDFILLS,
NUS Corp., Rockville, MD.
R. Nace, M. A. Jennison, Z. Kosim, D. Wilder, and P. Irle.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242466. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/530-SW-88-040, July 1988. 91p, 3 tab, 20 ref. EPA contract 68-01-7310.

Descriptors: *Municipal wastes, *Solid wastes, *Landfills, *Water pollution sources, Path of pollutants, Groundwater pollution, Surface water, Wildlife, Leachates, Runoff.

Human health and environmental impacts (excluding impacts from subsurface gas migration) have resulted from the operation of municipal solid waste landfills (MSWLFs). Where possible, the role of the design, operation, and location of the facility in creating the problem is reviewed to identify MSWLFs that have resulted in some type of adverse impact to groundwater, surface water, or wildlife. These efforts resulted in identifying 163 MSWLFs for which adverse impacts had been documented. For 111 of these sites, sufficient information was available to identify how design, operation, and location of the facility contributed to the problem. Groundwater contamination was the most commonly reported problem associated with MSWLFs. Thirty-five facilities were documented to have adversely affected private or community water supply systems. Site closure and improvements to the design and operating requirements of the unit were most common. Surface water contamination causes included discharges of leachate and contaminated runoff. Corrective actions for surface water contamination problems included drainage improvement or the installation of run-on and runoff control systems. (Lantz-PTT)
W89-09063

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: LOCATION RESTRICTIONS (SUBPART B),
NUS Corp., Rockville, MD.
R. Nace, M. A. Jennison, D. Wilder, G. Faison, and L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242425. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/530-SW-88-036, July 1988. 142p, 60 ref, append. EPA contract 68-01-7310.

Descriptors: *Regulations, *Waste disposal, *Municipal wastes, *Landfills, *Site selection, Standards, Legislation, Solid wastes, Federal jurisdiction, Design standards, Wetlands, Flood plains, Subsidence, Water pollution prevention, Landslides, Geologic fractures.

The 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) directed EPA to revise the Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257) for facilities that may receive household hazardous waste (HHW) or hazardous waste from small generators (SQGs). In carrying out this mandate, EPA has undertaken efforts to revise the current Criteria. EPA is initially limiting the Criteria revisions to municipal solid waste landfills (MSWLFs) because these are the only facilities for which the Agency has complete and reliable data. Section II of this document provides a discussion on the legislative and regulatory background and their status. Section III addresses other Federal laws that impact the design, operation, and location of MSWLFs. Section IV contains detailed information on the development of the standards addressing restricted locations, including airport areas,, floodplains, wetlands, fault areas, seismic impact zones, and geologically unstable areas (prone to landslides, subsidence). (Lantz-PTT)
W89-09064

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: DESIGN CRITERIA (SUBPART D),
NUS Corp., Rockville, MD.
R. Nace, M. A. Jennison, G. Jellick, D. Wilder, and L. Germany.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242482. Price codes: A06 in paper copy, A01 in microfiche. Report EPA/530-SW-88-042, July 1988. 113p, 1 tab, 50 ref, append. EPA contract 68-01-7310.

Descriptors: *Regulations, *Waste disposal, *Municipal wastes, *Landfills, Standards, Legislation, Solid wastes, Leachates, Water pollution prevention, Design standards, Federal jurisdiction, Linings.

In August 1988, the U.S. EPA proposed Solid Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid waste landfills. This background document provides the technical support for a portion of Subpart 'D'-Design Criteria of Part 258 and contains a discussion of information leading to the development of the categorical rule option. Detailed information on the revised design criteria is presented. The general development of the design criteria is discussed while the following items are specifically addressed: the various design options considered by the Agency, how the design standard was selected and alternatives considered, how location specific considerations are involved in the design standard, and what methodologies are available for meeting the design performance standard. A discussion of landfill designs addresses such items as liners, leachate collection systems, and final covers. (Author's abstract)
W89-09066

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: OPERATING CRITERIA (SUBPART C),
NUS Corp., Rockville, MD.
R. Nace, M. A. Jennison, D. Wilder, L. Butler, and M. M. Richardson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-242433. Price codes: A06 in paper copy, A01 in microfiche. Report EPA/530-SW-88-037, July 1988. 107p, 2 tab, 43 ref, append. EPA contract 68-01-7310.

Descriptors: *Regulations, *Waste disposal, *Municipal wastes, *Landfills, Standards, Legislation, Solid wastes, Runoff, Water pollution prevention, Federal jurisdiction, Design standards.

In August 1988, the U.S. EPA proposed Solid Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid waste landfills. This background document provides the technical support for a portion of Subpart 'C'-Design Criteria of Part 258. The revised operating criteria include procedures for: (1) excluding the receipt of hazardous waste; (2) cover material requirements; (3) controlling disease vectors; (4) monitoring for explosive gas; (5) complying with air criteria; (6) limiting access; (7) controlling run-on and run-off; (8) protecting surface waters; (9) restricting liquid wastes; and (10) record keeping. (Author's abstract)
W89-09067

SETTING PRIORITIES: THE KEY TO NONPOINT SOURCE CONTROL,
North Carolina State Univ. at Raleigh.
R. P. Maas, M. D. Smolen, C. A. Jamieson, and A. C. Weinberg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-243951. Price codes: A04 in paper copy, A01 in microfiche. July 1987. 51p, 2 fig, 4 tab, 25 ref. EPA cooperative agreement CR813100-01-0.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Management planning, *Wellhead protection areas, *Sole source aquifers, Monitoring, Regulations, State jurisdiction, Federal jurisdiction, Decision making, Watershed management, Groundwater.

Targeting is a straightforward concept--identify priority water resources and treat the major sources of pollutants that impair those resources first. However, variability in hydrological systems can complicate the targeting procedure. This document is a working outline of the procedure and can provide insight for state and local decision-makers involved in developing, administering and implementing nonpoint pollution source (NPS) control programs. Many specific recommendations are listed but the need for states and localities to be flexible in their NPS control efforts is recognized, too. No two water resource problems, state agency infrastructures or watershed landowners will be exactly alike. Thus, program flexibility to address a wide range of environmental and socio-economic factors must be anticipated. Specific goals and objectives, however, remain the focal point of NPS control programs to achieve water quality improvements. The development of a procedure to set priorities for state water resources should include such factors as: (1) the concerns of participating agencies; (2) establishment of realistic goals; (3) resources and capabilities; and (4) criteria such as water quality problems, economic factors, and political considerations. Two programs established in 1986 will affect state efforts to protect groundwater from nonpoint and other sources of pollution: (1) the Sole Source Aquifer Demonstration

Program and (2) the Wellhead Protection Program. Setting priorities at the watershed level follows once the state priorities have been established. The selection process should be based on the following five criteria; (1) type and severity of water resources impairment; (2) type of pollutants; (3) source magnitude; (4) transport; and (5) project specific criteria. (Lantz-PTT)
W89-09078

MODEL ASSESSMENT FOR DELINEATING WELLHEAD PROTECTION AREAS,
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
P. Van der Heijde, and M. S. Beljin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-231485. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA440/6-88-002, May 1988. 278p, 25 ref, 3 append. EPA contract 68-03-3252.

Descriptors: *Path of pollutants, *Wellhead protection areas, *Groundwater pollution, *Model studies, *Water pollution control, Solute transport, Mathematical models, Wells.

One element of the 1986 Amendments of the Safe Drinking Water Act (SDWA) of 1974 is the protection of wellhead areas from contaminants that may have an adverse effect on public health. In establishing wellhead protection areas (WHPA's), many factors need to be considered, such as the zone of influence around a well or wellfield, the presence of interfering neighboring wells or wellfields, water table drawdown by the wells or wellfields under consideration, various sources of contamination in the well recharge area (not necessarily the same as its zone of influence), and flow paths, transport velocities, and travel times for various contaminants under various hydrologic conditions. Information is presented on existing groundwater flow and contaminant transport and fate models that might be considered for use in a WHPA delineating study. Sixty-four models were screened by a computerized search in the model annotation databases of the International Ground Water Modeling Center (IGWMC). The models were chosen because of their availability, level of documentation, and applicability to the wellhead protection zone delineating problem. Fifty-one of the models are numerical, and 13 are analytical and semi-analytical. The report contains appendixes with summary descriptions and detailed information of each model, and a comparison of usability and reliability characteristics. (Lantz-PTT)
W89-09090

AMBIENT WATER QUALITY CRITERIA FOR ALUMINUM-1988.
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-245998. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA 440/5-86-008, August 1988. 47p, 6 tab, 125 ref.

Descriptors: *Water quality standards, *Aluminum, *Toxicity, Hydrogen ion concentration, Chlorides, Fluoride, Nitrates, Phosphates, Sulfates, Humic acids, Chemical reactions, Bioaccumulation, Regulations, Daphnia, Fish.

The chemistry of aluminum in surface water is complex because of five properties: (1) it is amphoteric; (2) ions such as chloride, fluoride, nitrate, phosphate, and sulfate form soluble complexes with aluminum; (3) it can form strong complexes with fulvic and humic acids; (4) hydroxide ions can connect aluminum ions to form soluble and insoluble polymers; and (5) under at least some conditions, solutions of aluminum in water approach chemical equilibrium rather slowly. Acute tests were conducted on aluminum at pH between 6.5 and 9.0 with freshwater species in 14 genera. In many tests, less than 50% of the organisms were affected at the highest concentration tested. Both ceriodaphnids and brook trout were affected at concentration below 4,000 microg/L, while other fish and invertebrate species were not affected by 45,000 microg/L. Chronic toxicity values for Daphnia magna, Ceriodaphnia dubia, and the fathead minnow were 742.2, 1.908, and 3.288 microg/L, respectively. Bioconcentration factors from 50 to 231 were obtained in tests with young brook trout. Because of the variety of forms of Al in ambient water and the lack of definition information about their relative toxicities to freshwater species, no available analytical measurement is known to be ideal for expressing aquatic life criteria for Al. At the present, acid-soluble Al is probably the best measurement. (Lantz-PTT)
W89-09113

REVIEW OF TECHNICAL DOCUMENTS: SUPPORTING PROPOSED REVISIONS TO EPA REGULATIONS FOR THE DISPOSAL/REUSE OF SEWAGE SLUDGE UNDER SECTION 405(D) OF THE CLEAN WATER ACT.
Environmental Protection Agency, Washington, DC. Science Advisory Board.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-243407. Price codes: A04 in paper copy, A01 in microfiche. Report No. SAB-EEC-87-015, January 1987. 78p, 4 fig, 31 ref, 6 append.

Descriptors: *Sludge disposal, *Sludge utilization, *Regulations, *Waste disposal, Waste renovation, Water reuse, Incineration, Ocean dumping, Land disposal, Risk assessments, Landfills.

In August 1985 the Environmental Engineering Committee of the Science Advisory Board of EPA was asked by the Office of Water Regulations and Standards (OWRS) to review technical documents supporting development of EPA regulations for the disposal/reuse of sewage sludge under Section 405(d) of the Clean Water Act. The Committee was also asked by the Office of Marine and Estuarine Protection (OMEP) to review technical documents supporting revisions of the EPA ocean dumping regulations. Some of the Committee's principal findings and recommendations are outlined. A working definition of risk, as used in these assessments, should be clearly articulated in the documents. The methodologies themselves include assumptions about management practices and changes that will mitigate risks. These assumptions should be clearly presented in the documents. For the purpose of generating supposed 'reasonable worst case' estimating many subjective and conservative assumptions are made. When combined, they produce multiplicative conservatism which can become unrealistic. The risk evaluations are based upon the concept of the 'Most Exposed Individual (MEI).' Sole reliance on the concept is flawed. The Committee has serious concerns about the uncertainties of the release and source characterization data for many sludge management practices. The documents should clearly acknowledge that certain factors have not been addressed: exposure to pathogens, degradation product, products of incomplete combustion, ecosystems effects, toxicities of mixtures, reversability of effects, and pharmacokinetics. The two major routes of exposure of the MEI in the landfilling option are the drinking of contaminated well water and inhalation of vapors in the air. Further recommendations address: (1) land application/distribution and marketing; (2) incineration; and (3) ocean disposal. (Lantz-PTT)
W89-09127

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

TOXICOLOGIC RISK MANAGEMENT AT THE COMMUNITY LEVEL: THE CASE OF CHEMICALLY CONTAMINATED GROUNDWATER USED AS DRINKING WATER,
Cornell Univ., Ithaca, NY. Graduate School.
For primary bibliographic entry see Field 5G.
W89-08242

RISK-ANALYSIS BASED STRATEGY ON MULTI-PURPOSE RESERVOIR SYSTEMS OPERATIONS,
Texas A and M Univ., College Station. Dept. of Urban and Regional Planning.
L. M. Cabezas-Canelos.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8605129. Ph.D. Dissertation, 1985. 172p, 20 fig, 30 tab, 102 ref, append.

Descriptors: *Multipurpose reservoirs, *Resource allocation, *Management planning, *Water resources management, Risks, Storage requirements, Storage capacity, Reservoir storage, Cost analysis, Texas, Waco Lake.

A generalized procedure for evaluating multipurpose reservoir systems is delineated based on risk, reliability, and storage reallocations between flood control and municipal and industrial water supply. The generalized procedure was applied to a proposed storage capacity reallocation in Waco Lake, Texas. The procedure was also evaluated by individuals from federal, state, and local agencies involved in reservoir operations, management, and planning in Texas. Application of the generalized procedure for evaluating the risks and consequences associated with the conflicting uses of Waco Lake indicate that economically optimum storage allocations vary with changes in water demand, as long as the characteristics of the flood plain are considered to be constant. But the high costs of implementing reallocation plans render most storage reallocations unfeasible. The determination of comparable expected costs of risk for conflicting reservoir purposes constitutes valuable additional information to water managers and decision makers for making more rational choices as decisions regarding allocations of limited resources become more difficult. (Cremmins-AEPCO)
W89-08244

DESIGNING CONTAMINATED GROUNDWATER REMEDIATION SYSTEMS USING NUMERICAL SIMULATION AND NONLINEAR OPTIMIZATION,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-08252

SHARED RESPONSIBILITY: WATER AND LAND PLANNING AND MANAGEMENT IN THE UNITED STATES,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 6B.
W89-08254

BALANCING PUBLIC AND PRIVATE INTERESTS IN WATER QUALITY PLANNING: MOTIVATIONS FOR PARTICIPATION,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6B.
W89-08258

HYDROLOGICAL INVERSE PROBLEM: RECONSIDERATION AND APPLICATION TO THE MICROCOMPUTER,
Florida State Univ., Tallahassee. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W89-08261

SIMULATION MODEL FOR MANAGING IRRIGATION PROJECTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-08265

DEVELOPMENT OF METHODOLOGIES FOR DETERMINING HYDROPOWER WATER STORAGE STRATEGIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-08266

Group 6A—Techniques Of Planning

DEVELOPING AN INTEGRATED MODEL FOR EVALUATING THE ECONOMIC AND ECOLOGIC EFFECTS OF REDUCING NONPOINT SOURCE POLLUTION IN A PALOUSE WATERSHED,
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
M. A. Brusven, and A. A. Prato.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115521/AS, price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Institute, Moscow, Completion Report, July 1988. 30p, 3 tab, 7 fig, 25 ref. USGS contract 14-08-0001-G1419. USGS project G1419-03.

Descriptors: *Nonpoint pollution sources, *Statistical models, *Idaho, *Watershed management, Tom Beall watershed, Erosion control, Farm income, AGNPS model, Ecological effects, Economic evaluation.

A linear programming model and the AGNPS model were used to determine those resource management systems that maximized total net farm income and reduced total erosion and nonpoint source pollution in Idaho's Tom Beall Watershed. Erosion decreased and water quality improved significantly with the optimal resource management systems. The optimal resource management systems for reducing erosion to 5 tons/acre/year (1T) and 10 tons/acre/year (2T) resulted in substantially lower sediment, nitrogen, phosphorus and chemical oxygen demand at the watershed outlet. Averaged over the four storm events (10, 25, 50 and 100 years), sediment, nitrogen, phosphorus and chemical oxygen demand declined by 45, 38, 38 and 24%, respectively, at the 2T level, and by 72, 64, 64, and 29%, respectively, at the 1T level. (USGS)
W89-08344

ENDOW: AN APPLICATION OF AN EXPERT SYSTEM IN TECHNOLOGY TRANSFER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
F. D. Shields.
Water Operations Technical Support Information Exchange Bulletin, Vol E-88-3, December 1988. 5p, 1 fig, 1 tab, 4 ref.

Descriptors: *Artificial intelligence, *Expert systems, *Information exchange, *Computer programs, *Technology transfer, ENDOW, Computers, Expert systems, Waterways, Bank protection, Civil engineering.

An expert system is a computer system that emulates some of the problem-solving ability of a human expert in a given field. Expert systems differ from procedural languages like FORTRAN in that they use logic and rules of thumb to assess data and solve problems. Expert systems are part of the larger field of artificial intelligence, and widespread application of both artificial intelligence and expert systems has not yet been attained. A simple expert system, ENDOW (for Environmental Design of Waterways), has been developed under the Water Operational Technical Support (WOTS) program to facilitate technology transfer to Corps field offices. The current release of ENDOW contains modules for streambank protection and flood-control channel projects, and a draft version containing an additional module for levee projects is in review. When running ENDOW, a user answers queries from the program regarding the project setting and environmental objectives. ENDOW then responds with a list of project features for further study and possible inclusion. Help screens that provide detailed descriptions of features and information about cost and performance can be requested for any feature selected. ENDOW Release 1.0 is presently available free of charge to users, and work on future releases continues. ENDOW Draft Version 3.0 is currently under technical review by a landscape architect and several biologists in the Waterways Experimental Station Environmental Laboratory. When the current review process is completed, the knowledge base in ENDOW Draft Version 3.0 will be transferred to new software using an expert system development tool ('a shell'). ENDOW Release 1.0 was written in the PROLOG language because the shells examined prior to software development were either too costly or too inflexible or both. (Lantz-PTT)
W89-08542

BUFFALO METROPOLITAN AREA, NY, ERIE COUNTY ALONG LAKE ERIE AND NIAGARA RIVER--SHORELINE PROTECTION INTERIM RECONNAISSANCE REPORT.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 2H.
W89-08553

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08572

LAND USE ALONG THE TANA RIVER, KENYA--A STUDY WITH SMALL FORMAT AERIAL PHOTOGRAPHY AND MICROLIGHT AIRCRAFT,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 7B.
W89-08574

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08577

SATELLITE DATA IN AQUATIC AREA RESEARCH: SOME IDEAS FOR FUTURE STUDIES,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 7A.
W89-08597

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08609

IDENTIFYING AND REDUCING LOSSES IN WATER DISTRIBUTION SYSTEMS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-08698

PROPOSED STUDY OF RECHARGE PROCESSES IN FRACTURE AQUIFERS OF SEMI-ARID BOTSWANA,
Botswana Univ., Gaborone. Faculty of Science.
For primary bibliographic entry see Field 2F.
W89-08837

WATER-RESOURCES ACTIVITIES IN OHIO, 1986.
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09213

6B. Evaluation Process

SHARED RESPONSIBILITY: WATER AND LAND PLANNING AND MANAGEMENT IN THE UNITED STATES,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
R. F. Dworsky.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8622666. Ph.D. Dissertation, 1986. 256p, 1 fig, 8 tab, 110 ref.

Descriptors: *Water resources development, *Regional planning, *Management planning, *Land resources, Federal jurisdiction, Governmental interrelations, Regional development, Case studies, Resources development, Resources management.

Regional planning and management organizations for water and land resources were evaluated to determine how they can be effective and responsive within a social environment whose main characteristic is change. Federalism and intergovernmental planning experiences were examined in terms of shared responsibility for the origins and evaluation of efforts to manage natural resources in the public sector. Natural resources management case studies dealing with water and land planning in New York, Puerto Rico, Vermont, and Alaska are discussed. Management must develop capabilities to recognize and adapt to change when it is imminent or when it occurs. Control of the rate of change, or of indiscriminate and damaging change, when desirable and feasible, must also be sought as a useful capability. Planning for natural resources must consider new methods of conflict resolution. These methods must be evaluated for public participation as well as on the political question of plan implementation. (Cremmins-AEPCO)
W89-08254

BALANCING PUBLIC AND PRIVATE INTERESTS IN WATER QUALITY PLANNING: MOTIVATIONS FOR PARTICIPATION,
North Carolina Univ., Chapel Hill. Dept. of City and Regional Planning.
B. S. Stiftel.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8711168. Ph.D. Dissertation, 1986. 283p, 19 fig, 39 tab, 628 ref, append.

Descriptors: *Public participation, *Water quality, *Model studies, *Benefits, *Planning, *Motivation, Surveys, Social participation.

The underrepresentation of public interests and the overrepresentation of private interests in water quality planning were studied based on the rewards and motivations of participation. A General Model of Participation in Planning is developed and a set of assertions concerning differential incentives and obstacles for participation between public and private participants is derived from the model. The model was tested using data about citizen participants in the North Carolina statewide water quality planning program. The model is based on interest group, collective action, and exchange theories; the socioeconomic model of participation; and synanthrometrics. Analysis of a participant survey indicates that private interests participate more than public interests, public interests value collective material rewards more than private participants, but only limited support is found for the expectation that private interests value selective material rewards more than public participants. No differences were found for value placed on solidary and expressive rewards by the two interests. Rewards are found to be related to levels of participation only sporadically. (Cremmins-AEPCO)
W89-08258

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 3D.
W89-08449

THEMATIC MAPPING FROM AERIAL PHOTOGRAPHS FOR KANDI WATERSHED AND AREA DEVELOPMENT PROJECT, PUNJAB, INDIA,
Planning & Design St.Directorate (IB), Punjab, Chandigarh, India.
For primary bibliographic entry see Field 7C.
W89-08578

WATER RESOURCES POLICY FOR ASIA.
Proceedings of the Regional Symposium on Water Resources Policy in Agro-Socio-Economic Development, Dhaka, Bangladesh, 4-8 August 1985. A.A. Balkema, Rotterdam, Netherlands. 1987. 627p. Edited by Mohammed Ali, George E. Radosevich and Akbar Ali Khan.

Descriptors: *Economic aspects, *Alternative planning, *Asia, *Agriculture, *Developing countries, *Social aspects, *Water resources development, *Water policy, Water management, Groundwater management, Planning, Water law, Southeast Asia, Symposium.

In association with the United States Agency for International Development, Dhaka, the Ministry of Irrigation, Water Development and Flood Control in Bangladesh organized a regional symposium held in Dhaka August 4-8, 1985 on 'The Role of Water Resources Policy In Agro-Socio-Economic Development'. The present volume contains the papers presented in this symposium. The papers fall in 3 categories: Part I, Problems--Problem S666ing, Part II, Policies--Substantive Alternatives in Water Policy and Law; and Part III, Practices--Planning and Implementation Processes. There is also a summary of panel discussions. The structure of this volume is guided by the underlying effort of discussing issues, problems, and solutions affecting the planning and implementation of water resources management through the interaction of water resources experts in a variety of disciplines, governmental policy makers, and water administrators. The primary purpose is to focus on the role of a coherent policy framework and the related institutional framework associated with the development, utilization, and management of national and transnational surface and groundwater resources. (See W89-08900 thru W89-08933) (Sand-PTT)
W89-08899

POLICY FRAMEWORK AND INSTITUTIONS FOR WATER RESOURCES PLANNING, DEVELOPMENT, AND MANAGEMENT IN PAKISTAN,
Pakistan Water and Power Development Authority, Lahore.
M. Badruddin.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 105-117, 3 fig.

Descriptors: *Irrigation requirements, *Multiobjective planning, *Water resources development, *Water management, *Water policy, *Policy making, *Pakistan, *Developing countries, Agriculture, Groundwater management, Watershed management, Planning, Wells, Reservoirs, Navigation, Irrigation, Recreation facilities, Saline water, Land reclamation, Economic aspects, Saline soils, Public health, Conjunctive use, Investment.

Agriculture in Pakistan is greatly dependent on irrigation, the irrigated area accounting for 90% of the total agricultural production. The primary agency dealing with water resources at the federal level is the Water and Power Development Authority, which is concerned with: the prevention of waterlogging, reclamation of saline lands, and disposal of drainable surplus (saline) from the irrigated areas; irrigation water supply and recreational uses of water resources; inland navigation; flood control and watershed management; and prevention of any public health effects resulting from operations of the organization. The principal problems associated with water resources planning, development and management have been addressed under two sets of policy recommendations - one dealing with water-related matters and the other with financial matters. With respect to the water-related policies, the provision of 'controlled' and/or 'guaranteed' water supply is regarded as the key to improving farm production. The objectives are addressed by the following policy recommendations: (1) all future developments of usable groundwater should be entrusted to the private sector, with the assistance of the public sector in the form of supervised credit, technology supply, and information; (2) present public tubewells in usable groundwater areas would be gradually phased out and replaced by private tubewells; (3) basin-wide management would be a major objective of the government through the integrated use of rivers and reservoirs, conjunctive use of surface and groundwater, and advance crop planning. Financial policies are addressed to the creation of an economic environment that will provide incentives for increased production, and to implement the strategy of increased mobilization of domestic saving to finance further investment. (See also W89-08899) (Sand-PTT)
W89-08907

IMPLEMENTING WATER RESOURCES POLICIES: SOCIAL CONSIDERATIONS,
Colorado State Univ., Fort Collins. Dept. of Sociology.
For primary bibliographic entry see Field 6E.
W89-08925

ECONOMIC CONSIDERATIONS AND ALTERNATIVES IN WATER POLICY FORMULATION FOR BANGLADESH,
PATC, Dhaka, Bangladesh.
A. A. Khan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 459-484, 6 tab, 39 ref.

Descriptors: *Alternative planning, *Optimum development plans, *Water resources development, *Water policy, *Bangladesh, *Developing countries.*Planning, *Economic aspects, *Irrigation, *Agriculture, Flood control, Fisheries, Navigation, Domestic water use, Industrial water use, Rice, Technology, Wells, International agreements.

The interrelationships of various uses of water in Bangladesh has made the task of water development extremely complex. Because of lack of policies and resources, water development has so far proceeded on an ad hoc basis. What is needed is an integrated approach so that solutions of some problems do not create problems of different types. Several biases in the existing water schemes can be identified: a technological bias that discriminates against traditional methods which are in line with the socioeconomic realities of the country; a rice bias in planning that overlooks the needs for fishery and navigation; a tubewell bias that favors the import-oriented groundwater development; and a flood control bias which is indifferent to the externalities and linkages of such schemes. Most of the projects in the water sector are not optimally used due to lack of suitable organizations. The projects should be examined not only from the technical but also from the beneficiaries' point of view. The country has to find ways to develop surface water resources to meet the demands for water in the near future. The tradeoffs in the water sector cannot be resolved on economic considerations alone. The scope of viable projects will vary according to political scenarios, of which there are two options: autarkic water development, or development of water resources in cooperation with co-riparian states. From an economic point of view, the development of water resources without cooperation of co-riparian states will be highly expensive. (See also W89-08899) (Sand-PTT)
W89-08926

TECHNICAL CONSIDERATIONS IN WATER POLICY FORMULATION AND IMPLEMENTATION,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
G. V. Skogerboe.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 485-494, 4 fig, 4 ref.

Descriptors: *Water resources development, *River basin development, *Water policy, *Planning, Structural engineering, Management planning, Project planning.

In the early stages of river basin development, there is a reliance on physical structures (hardware), while software (management) solutions are mostly needed as the water supplies become more fully utilized. Developing and implementing software solutions must rely on known processes that can be adapted to local conditions, rather than using prescriptive approaches, which is difficult for governmental agencies having a history of hardware development. Flexibility during implementation is important so that the program can be refined based on monitoring and evaluation results, thereby helping to accommodate the 'learning process' being sensitively adapted to local conditions. This article discusses the technical factors to be considered for a more successful integrated design and operation of water systems. (See also W89-08899) (Sand-PTT)
W89-08927

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-09031

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

INNOVATIVE PRICING FOR RESIDENTIAL WATER SUPPLY,
Clark Univ., Worcester, MA. Dept. of Geography.
R. D. Obeiter.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8623642. Ph.D. Dissertation, 1986. 164p, 15 tab, 70 ref, 2 append.

Descriptors: *Pricing, *Water supply, *Domestic water, *Cost analysis, *Water use, Tariff, Water demand, Water conservation, Case studies, Marginal costs.

A methodology was developed for innovative pricing of water supply based on marginal costs. The results were evaluated of an experiment designed to elicit customer response to a time-differentitated rate structure for water supply based on peak load pricing. Water using behavior of a group of residential consumers was also studied, and implications for the development of innovative tariffs for water supply were examined. Results indicate that the demand for water supply was not as sensitive to price as expected. Response to time differentiated prices was almost identical to that for experimental pricing. There was no difference in off-peak consumption among any of the study groups and only 50% of the time was there any difference in on-peak consumption patterns. Water using behavior was not significantly affected by price. Alternative pricing was an acceptable rate structure. Water was perceived as being a valuable resource, worth conserving. Conservation, however, was the result of a moral conservation ethic and not related to price incentives. Time of use pricing for residential water supply would probably not affect efficiency gains in excess of the costs of the more expensive meters required to record consumption by time of day. (Cremmins-AEPCO)
W89-08259

FEASIBILITY STUDY OF THE PRIVATIZATION OF PUBLIC WASTEWATER TREATMENT WORKS,
Auburn Univ., AL. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W89-08404

COST EFFECTIVENESS OF THE STREAM FLOW-GAGING PROGRAM IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08409

COST EFFECTIVENESS OF STREAM-GAGING PROGRAM IN MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08672

SMALL WATER SYSTEM TREATMENT COSTS,
Culp/Wesner/Culp, Santa Ana, CA.
For primary bibliographic entry see Field 5F.
W89-08700

COST EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08828

COST-BENEFIT ANALYSIS OF A PROPOSED STORM SURGE BARRIER ON THE RIVER SCHELDT (BELGIUM),
Katholieke Univ. Leuven (Belgium).
For primary bibliographic entry see Field 4A.
W89-08892

SOME ASPECTS OF U.S. GEOLOGICAL SURVEY ACTIVITIES RELATED TO THE EFFECTS OF CONTAMINANTS ON WATER RESOURCES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-09008

6D. Water Demand

ECONOMIC ANALYSIS OF CONJUCTIVE USE OF WATER: THE CASE OF MAHI-KADANA IRRIGATION PROJECT IN GUJARAT, INDIA,
Illinois Univ. at Urbana-Champaign. Graduate Coll.
For primary bibliographic entry see Field 3F.
W89-08243

RISK-ANALYSIS BASED STRATEGY ON MULTI-PURPOSE RESERVOIR SYSTEMS OPERATIONS,
Texas A and M Univ., College Station. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 6A.
W89-08244

INNOVATIVE PRICING FOR RESIDENTIAL WATER SUPPLY,
Clark Univ., Worcester, MA. Dept. of Geography.
For primary bibliographic entry see Field 6C.
W89-08259

WATER RESOURCES AND PROVISION PROBLEMS OF RIYADH, SAUDI ARABIA: AN ANALYTICAL STUDY,
Oregon Univ., Eugene. Dept. of Geography.
K. Al-Mudaiheem.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8605825. Ph.D. Dissertation, 1985. 261p, 39 fig, 24 tab, 131 ref, 2 append.

Descriptors: *Water resources development, *Economic aspects, *Developing countries, *Groundwater management, *Water demand, *Water supply, Geography, Irrigation programs, Cost analysis, Wastewater treatment, Seawater.

The economic and geographic characteristics of water in the city of Riyadh were studied to determine their potential for meeting increasing water demand amid rising water exploitation costs. The management of groundwater withdrawal and use was also studied. Water resources and management problems in Riyadh were compared with those in Tuscon, Arizona. The shallow aquifers of the Riyadh region in Wadi Nisah should be used exclusively for Riyadh's water supply because of their low water development costs. Other shallow groundwater users in the Al Ha'ir Basin and Wadi Nisah, such as farmers, should benefit from one of the following alternatives: (1) monetary compensation or an offer of farmland in areas outside the Riyadh region; (2) farmers should be allowed to drill wells into Minjur Aquifer, since the piezometric level is shallow and the aquifer is artesian at the east end of Nisah; and (3) farmlands in the Upper Wadi Hanifah can be supplied with high quality treated sewage effluent with use of proper irrigation methods. For maximum advantageous groundwater use, farmers should be encouraged to use the most advanced irrigation methods and techniques to reduce overflow and water evaporation. (Cremmins-AEPCO)
W89-08263

HISTORY OF NEW MEXICO STATE UNIVERSITY'S WELL DEVELOPMENT AND GROUNDWATER USE,
New Mexico Water Resources Research Inst., Las Cruces.
C. Lashway.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-109763/AS, price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report No. 232, July 1988. 130p, 37 fig, 1 tab, 55 ref. USGS state project 13454651.

Descriptors: *New Mexico, *Groundwater, *Irrigation water, *Wells, *History, Water use, Water demand, Surface water, Domestic water.

During the past one hundred years, New Mexico State University (NMSU) students, faculty and staff, have had an increasing demand for water to meet their domestic, educational and research needs. The Experiment Station, an integral part of NMSU, has also required water to fulfill its agricultural research responsibilities to the people of New Mexico. Because of the Rio Grande's uncertain flow, and NMSU's continual growth, the river has never been able to meet these educational and research needs. The university found the only way it could meet these needs in a semiarid climate was to drill wells for access to groundwater. The drilling of these wells is a vital part of the university's history. Without access to underground water NMSU would not exist as it is known today, an institution providing education in agriculture, engineering, and the humanities to 14,000 students. This study examined how the university has used its surface and groundwater resources during the past one hundred years. Emphasis was placed upon the development of wells for domestic, irrigation and economic purposes. The study is confined to NMSU's main campus, as well as other university properties located in the Mesilla Valley, but which are not a part of the main campus. (Lashway-NMWRRI)
W89-08330

WATER SUPPLY AND DEMAND FOR NEW MEXICO 1985-2030 - RESOURCE DATA BASE,
New Mexico Water Resources Research Inst., Las Cruces.
R. R. Lansford, J. W. Hernandez, G. Burner, C. Lightfoot, and J. Costello.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-113930/AS, price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. M18, May 1988. 93p, 29 fig, 51 tab, 13 ref. USGS state project 1345674.

Descriptors: *Databases, *Water supply, *Water use, *Water demand, *Water depletion, Water management, Water quality, Data collection, Water scarcity, Projections.

A report titled, Water: Lifeblood of New Mexico was prepared by the New Mexico Water Resources Research Institute for New Mexico First to serve as a briefing document for the Second Town Hall seminar. The goal of that document was to present generalized information on the availability, use, and management issues relative to the state's water supply. The participants of the seminar would use the information in formulating opinions in developing recommendations for policies and actions that would affect the availability and future use of New Mexico's water resources. The purpose of this report is to provide supplementary data on the water supply and future water use that was developed in the process of writing the New Mexico First briefing report. The report provides data related to water supply for future use, water demands in New Mexico, projected water depletions for three scenarios on a basin-by-basin basis and potential economic growth scenarios. (Lansford-NM St U.)
W89-08347

INVENTORY OF INTERBASIN WATER TRANSFERS IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
L. C. Trotta.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-466, (1988).

Descriptors: *Interbasin transfers, *Minnesota, Water conveyance, Sewers, Groundwater infiltration.

Water transfer data were collected by the U.S. Geological Survey, in cooperation with the Minnesota Department of Natural Resources, from the 13 hydrologic subregions in Minnesota. About 30,000 acre-ft of water is exported annually from eight of these subregions. Interbasin transfer of water is classified according to type of water conveyance in Minnesota. This information is needed by water-system managers and planners to develop water budgets for major river basins, to examine the extent of existing interbasin transfers, and to evaluate the feasibility of transferring water to meet regional water demands. (USGS)
W89-08377

WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA, 1985,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. L. Marella.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4103, 1988. 43p, 31 fig, 11 tab.

Descriptors: *Water use, *Florida, *Water resources data, *Groundwater use, Surface water, Saline water, Cooling water.

Total water withdrawn for use in Florida for 1985, in million gal/day, was 17,057 of which 6,259, or nearly 37%, was freshwater and 10,798 was saline. The majority of freshwater withdrawn was groundwater (64%) and the majority of saline water withdrawn was surface water (99%). Thermoelectric power generation accounted for more than 99% of saline water withdrawals. Agricultural irrigation accounted for the majority of freshwater withdrawals for both groundwater (41%) and surface water (60%) in 1985. Between 1975-85, Florida's population increased by nearly 3 million people; tourism increased by nearly 13 million visitors; irrigated agricultural acreage increased by 70,000; freshwater used to support those activities increased by almost 388 million gal/day (excluding fresh surface-water withdrawals for thermoelectric power generation); and fresh groundwater withdrawals increased 718 million gal/day. Groundwater accounted for 64% of Florida's total freshwater use, up from 51% in 1980 and 48% in 1975. Florida ranked sixth in the Nation in groundwater withdrawals for 1985 with more than 4,000 million gal/day withdrawn. Groundwater is the primary source of freshwater in Florida because it is readily available and generally is suitable for most uses. The Floridan aquifer system, which underlies the entire State, supplied the majority (62%) of groundwater in Florida for 1985. In contrast to groundwater, withdrawals of surface water declined between 1975-85. (USGS)
W89-08420

ESTIMATES OF CONSUMPTIVE USE AND GROUNDWATER RETURN FLOW USING WATER BUDGETS IN PARKER VALLEY, ARIZONA, AND CALIFORNIA, 1981-84,
Geological Survey, Tucson, AZ. Water Resources Div.
S. J. Owen-Joyce.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4063, 1988. 64p, 21 fig, 17 tab, 20 ref.

Descriptors: *Consumptive use, *Irrigation-return flow, *Return flow, *Evapotranspiration, *Water use, *Irrigation water, *Arizona, *California, Water levels, Hydrologic budgets, Vegetation, Agriculture, Hydrologic system, Southwestern United States, Parker Valley, Lower Colorado River.

Annual water budgets were used to estimate consumptive use by vegetation and groundwater return flow in Parker Valley, Arizona and California. Consumptive use by vegetation was estimated to be 482,800 acre-ft in 1981, 432,000 acre-ft in 1982, 413,500 acre-ft in 1983, and 420,900 acre-ft in 1984 on the Arizona side of the Colorado River, and 45,400 acre-ft in 1984 on the California side of the river. Groundwater return flow from the area north of Tyson Wash in Arizona was estimated to be 0 acre-ft in 1981, 1983, and 1984 and 1,900 acre-ft in 1982. Water budget estimates of consumptive use by vegetation were compared to estimates of evapotranspiration. Estimates of evapotranspiration were from 1% less to 9% higher than estimates of consumptive use by vegetation in the area north of Tyson Wash. The percentage differences in the two estimates were within the measurement errors of the two major measured components in the water budget regardless of differences in year-to-year conditions. Estimates of consumptive use of Colorado River water calculated as measured diversions minus return flows were consistently lower than estimates of consumptive use by vegetation. Estimates of consumptive use of Colorado River water were from 18 to 37% lower than estimates of consumptive use by vegetation variations in tributary inflow, river stage, and induced seepage from the river to replace groundwater transpired by phreatophytes are not accounted for in the calculation. (USGS)
W89-08428

ESTIMATED USE OF WATER IN COLORADO, 1985,
Geological Survey, Denver, CO. Water Resources Div.
D. W. Litke, and C. L. Appel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigations Report 88-4101, 1989. 157p, 10 fig, 24 tab, 37 ref.

Descriptors: *Water use, *Consumptive use, *Colorado, *Depletions, Public supply, Domestic water use, Commercial waste use, Industrial water use, Power, Agricultural water use, Mining water use, Irrigation.

Water-use data was collected for the State of Colorado as part of the U.S. Geological Survey's National Water-Use Information Program. An estimated 20,800 million gal/day of water were used in Colorado during 1985. 89% came from surface water sources and 11% came from groundwater sources. Public supply systems provided 4% of all water used in Colorado during 1985, but provided 80% of all commercial, domestic, and industrial water used. An estimated 4,840 million gal/day of water were consumed during 1985; return flows amounted to 16,000 million gallons per day. Of all water used, 60% was used for irrigation, 35% for hydroelectric power generation, and the remaining 5% for commercial, domestic, industrial, livestock, mining, and other uses. The most water was used in Montrose (3,260 million gal/day), Mesa (1,950 million gal/day), and Gunnison (1,520 million gal/day) Counties. The predominant water uses in these counties were hydroelectric power and irrigation. (USGS)
W89-08431

ECONOMIC EVALUATION OF CONSERVATION CONCEPTS FOR MUNICIPAL WATER SUPPLY SYSTEMS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 3D.
W89-08449

WATER USE IN MISSISSIPPI, 1980,
Geological Survey, Jackson, MS. Water Resources Div.
J. A. Callahan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-224, 1983. 1p (map), 3 fig, 2 tab, 6 ref.

Descriptors: *Water use, *Mississippi, *Management planning, Surface water, Groundwater budget, Competing use, Industrial water, Hydroelectric plants, Irrigation, Aquaculture.

Large quantities of good quality ground and surface water are readily available in nearly all parts of Mississippi, and there is also an abundant supply of saline water in the estuaries along the Mississippi Gulf Coast. The total estimated water use in the State in 1980 from groundwater and surface water was 3532 million gallons/day (mgd), including 662 mgd of saline water. Freshwater used from all sources in Mississippi during the period 1975 through 1980 increased from 2510 mgd to > 2870 mgd, a 14% increase. Although modest increases of freshwater use may be expected in public, self-supplied industrial, and thermoelectric supplies, large future increases in the use of freshwater may be expected primarily as a result of growth in irrigation and aquaculture. Management and protection of the quantity and quality of the available freshwater supply are often problems associated with increased use. Water use data, both temporal and spatial, are needed by the State of Mississippi to provide for intelligent, long-term management of the resources; one table gives data on the principal categories of water use, sources, and use by county. (Lantz-PTT)
W89-08659

DEVELOPMENT OF A WATER-USE DATA SYSTEM IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. A. Horn.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4306, 1986. 59p, 7 fig, 3 tab, 9 ref, 2 append.

Descriptors: *Water use, *Data acquisition, *Minnesota, *Data storage and retrieval, *Information systems, Regulations, Permits, Water resources development, Water management, Computer programs, Computers.

The Minnesota State Legislature passed laws as early as 1937 to regulate use of Minnesota's groundwater and surface water through a permit system. Several unsuccessful attempts were made to computerize water use data reported to the State. The U.S. Geological Survey, through the National Water-Use Information Program, assisted the Minnesota Department of Natural Resources and the Minnesota State Planning Agency, Land Management Information Center, in developing MWUDS (Minnesota Water-Use Data System). The Minnesota Water-Use Data System stores data on the quantity of individual annual water withdrawals and discharges in relation to the water resources affected, provides descriptors for aggregation of data and trend analysis, and enables access to additional data contained in other data bases. MWUDS is stored on a computer at the Land Management Information center, an agency associated with the State Planning Agency. Interactive menu-driven programs simplify data entry, update, and retrieval and are easy to use. Estimates of unreported water use supplement reported water use to completely describe the stress on the hydrologic system. Links or common elements developed in the MWUDS enable access to data available in other State water related data bases, forming a water resource information system. Water use information can be improved by developing methods for increasing accuracy of reported water use and refining methods for estimating unreported water use. (Author's abstract)
W89-08693

GROUND-WATER RESOURCES OF JONES COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08759

ESTIMATED USE OF GROUND WATER FOR IRRIGATION IN WISCONSIN, 1984,
Geological Survey, Madison, WI. Water Resources Div.
J. T . Krohelski, B. R. Ellefson, and C. A. Storlie.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4079, 1987. 12p, 1 fig, 3 tab, 1 plate, 4 ref.

Descriptors: *Water use, *Groundwater irrigation, *Wisconsin, *Groundwater management, Agriculture, Groundwater depletion, Irrigation practices, Mathematical equations, Pumpage.

The flow from a sample of 143 irrigation wells from 6 irrigation areas in Wisconsin was measured using an external flowmeter during the 1983-84 irrigation seasons. The measured pumpages were correlated with reported pumpages. The equation that describes this correlation is Q(sub)m = 0.86 x Q(sub)r where Q(sub)m is the measured pumpage and Q(sub)r is the reported pumpage. This equation was used to adjust all reported irrigation pumpage, yielding a more accurate estimate of total irrigation water use. The maximum total irrigation pumpage for 1984 was estimated to be 31,700 million gallons by using the equation and accounting for both reported and unreported pumpage. From 1979 to 1984, irrigation pumpage increased a maximum of 25% and the maximum number of irrigation wells increased 32%. (Author's abstract)
W89-08769

WATER USE IN THE UNITED STATES, 1980,
W. B. Solley, N. L. Barber, and C. F. Merk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4182. 1p, 7 fig, 6 map, 7 ref.

Descriptors: *Water use, Surface waters, Groundwater depletion, Municipal water, Irrigation, Industrial water, Electric powerplants, Rural areas.

National estimates of water use, compiled every 5 years since 1950 by the U.S. Geological Survey, with estimates and trends in water withdrawals 1950-1980, are presented graphically for the following categories of use: public supply, rural, irrigation, self-supplied industrial, including thermoelectric power and other industries. 'Withdrawal use' of water, includes water withdrawn or diverted from ground- or surface-water sources for uses such as public supply, rural irrigation and industrial. Withdrawal estimates are summarized as average daily quantities withdrawn expressed in billion gal/day and are derived from annual estimates. (Lantz-PTT)
W89-08770

ESTIMATE OF LIVESTOCK WATER USE IN NEBRASKA DURING 1980,
Geological Survey, Lincoln, NE. Water Resources Div.
E. K. Steele.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4031, 1986. 38p, 12 fig, 7 tab, 8 ref.

Descriptors: *Water use, *Livestock, *Nebraska, Economic aspects, Hat Creek, Elkhorn River, South Platte River, Estimating.

The estimated volume of 148,120 acre-ft of water used by livestock in Nebraska during 1980 is the second largest (after Texas) volume used for livestock production in the fifty Sates. Although water used by livestock is a small percentage of the total water used in Nebraska, this use has a major impact on the farm economy of the State, as livestock sales accounted for 59% of the total farm market cash receipts in 1980. About 16%, or 23,590 acre-ft, of this use is estimated to be from surface water sources, with the remaining 124,530 acre-ft pumped from the State's groundwater supply. The estimated livestock water use in Nebraska's 93 counties during 1980 ranged from 340 acre-ft in Hooker County to 6,770 acre-ft in Cherry County. Livestock water use by Hydrologic Units ranged from 20 acre-ft in the Hat Creek basin 10120106) to 10,370 acre-ft in the Elkhorn River basin, and the Natural Resources Districts' use ranged from 1,880 acre-ft in the South Platte NRD to 17,830 acre-ft in the Lower Elkhorn NRD. (Author's abstract)
W89-08781

WATER DEMANDS IN KANSAS, 1944-84,
Geological Survey, Lawrence, KS. Water Resources Div.
J. F. Kenny.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4038, 1986. 17p, 15 fig, 9 ref.

Descriptors: *Water use, *Kansas, *Competing use, *Water rights, *Water demand, Groundwater potential, Irrigation, Industrial water, Permits, Water demand, Water allocation.

The State of Kansas has administered water rights according to an appropriations doctrine since 1945. Water rights are issued by the Kansas State Board of Agriculture, Division of Water Resources, for eight categories of beneficial use. Water rights data and limited information on reported water use are stored on a computerized State data base; the U.S. Geological Survey cooperates with the State on maintenance of this system. This report analyzes trends in appropriations from 1944-84 for surface and groundwater for three major categories of use: irrigation, public supply, and industry. Demands for water, represented by these appropriations, are compared for three geographic areas within the State. These areas correspond to general patterns of water availability, population, and enterprises. As of 1984, 87% of the water appropriated for the three major types of use was for irrigation; most of this demand was for groundwater in the western one-third of the State. Seventy-five percent of the water demands in the central one-third of Kansas were met by groundwater; appropriations for irrigation represent the largest demand on water supplies in this area but must compete with appropriations for public supply and industry. Demands for surface water have increased substantially only in the eastern part of the State for industrial use and public supplies. The most prominent trends in water rights permit activity were related to climatic fluctuations, particularly the drought of the 1950's, legislative changes in the 1970's requiring permits, and growth of urban populations in the central and eastern areas of the State. Analysis of trends in water appropriations can be useful in understanding the water issues facing Kansas in the future. (Author's abstract)
W89-08788

WATER RESOURCES UTILIZATION FOR AGRICULTURE IN THAILAND,
Royal Irrigation Dept., Bangkok (Thailand).
P. Kanoksing.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 127-135. 1 tab.

Descriptors: *Crop production, *Water use, *Water resources development, *Irrigation practices, *Thailand, *Developing countries, Planning, Agriculture, Rice, Social costs, Land use, Domestic water, Interagency cooperation, Public participation, Social aspects, Economic aspects.

Thailand has become the worlds' largest rice exporter. However, the achievements must be seen in a context as the increase in food grain production has been attained at a high social cost. Together with increasing population pressures on land, increasing agricultural output has to turn to improving productivity through intensive land use and improved technologies. The trend of irrigation development in Thailand places an emphasis on modernization of the existing system, distribution of water from existing sources, and small scale irrigation. High priority is also placed on small scale water resources development to meet the basic subsistence requirements for domestic water needs and for minimal supplementary irrigation. Although irrigation development has been accomplished to some extent in terms of area covered, the investment still does not yield the promised economic and social benefits satisfactorily. Improvement from both coordination among various agencies concerned and farmers' participation are essential. (See also W89-08899) (Sand-PTT)
W89-08909

WATER RESOURCES SITUATION IN BANGLADESH,
Ministry of Irrigation, Water Development and Flood Control, Dacca (Bangladesh).
T. A. Khan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 139-164, 4 fig, 4 tab, 12 ref.

Descriptors: *Water resources development, *Water supply development, *Water use, *Bangladesh, *Developing countries, Agriculture, Fisheries, Navigation, Planning, Industrial water, Domestic water, Drinking water, Rivers, Water table decline, Saline water intrusion, Monsoons, Drought, Water scarcity, Groundwater mining, Limiting factors, Available water, Irrigation requirements, Surface water.

Excessive water during the monsoon and lack of it during the dry season are the two factors which dominate the water resources situation in Bangladesh. On an annual basis, huge supplies of water are available, but during the dry winter months the flows in the major rivers diminish drastically and most of the small rivers dry up, leading to a scarcity of fresh water for use in agriculture, fisheries, navigation, and industry, as well as for drinking and domestic use. With the rapid increase in population, the demand for water in every sphere of the economy is also increasing. The potential for groundwater exploitation is nearing the critical limit. The scope of further development and utilization of groundwater resources is limited by hydrological, hydrogeological, and other conditions. The surface water availability is also facing increasing setbacks. Flows in some of the rivers have been reduced considerably in recent years as a result of upstream diversions across the border of Bangladesh, causing lowering of the water table, salinity intrusion, and reduction in navigability of some of the major water routes. The reduction of river flows is also adversely affecting the mangrove forest ecosystem, fish production, and agriculture in areas dependent on these rivers for irrigation during the dry season. These problems point out the need for large-scale surface water developments, as the potential for further development in groundwater is limited. (See also W89-08899) (Sand-PTT)
W89-08910

NATIONAL WATER GOALS, POLICIES, AND LAWS: THE INSTITUTIONAL FRAMEWORK,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 6E.
W89-08914

CASE STUDY OF MINIMUM STREAMFLOW FOR FISHERY HABITAT IN THE YAMPA RIVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08964

PRELIMINARY WATER-USE ESTIMATES IN THE UND STATES IN 1985,
Geological Survey, Reston, VA. Water Resources Div.
W. B. Solley, R. R. Pierce, and C. F. Merk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-692, 1987. 4p, 4 tab.

Descriptors: *Water use, *Data collections, Groundwater depletion, Surface water.

Preliminary 1985 water use estimates are tabulated by State for the Und States, Puerto Rico, the Virgin Islands, and the District of Columbia. Preliminary estimates of water withdrawn from surface water and groundwater sources for offstream water use categories are presented prior to publication of the final estimates in a U.S. Geological Survey Circular to allow for the timely release of the estimates to the general public. (Author's abstract)
W89-09002

WATER-USE INFORMATION FOR CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
W. E. Templin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-483, (1986). 6p, 1 fig, 5 photos, 3 ref.

Descriptors: *Water use, *California, *Information storage and retrieval, Agriculture, Industrial water, Wastewater treatment, Hydroelectric power, Groundwater budget, Water supply, Domestic water, Irrigation.

This pamphlet reports on the availability of water use information to and for the state of California, through the development of the State Water-Use Data System (SWUDS). SWUDS is currently organized into 12 water use categories: Agricultural non-irrigation; Commercial; Domestic; Industrial; Irrigation; Mining; Power generation--fossil fuel, geothermal, hydroelectric, nuclear; Sewage treatment; and Water supply. The information needs of this system include type of water use (by category); name of water user; location of water use (latitude/longitude, county, and hydrologic unit--drainage basin); sources of water supply and return (fresh, saline, or reclaimed surface or groundwater); volume of water withdrawn, delivered, consumed, released, and returned; and period of water use (month, year). (Lantz-PTT)
W89-09124

DAMS, RESERVOIRS AND WITHDRAWALS FOR WATER SUPPLY--HISTORIC TRENDS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09220

6E. Water Law and Institutions

POLITICAL ECONOMY OF NATURAL RESOURCES: WATER SCARCITY IN THE HIGH PLAINS REGION OF THE U.S.,
Columbia Univ., New York. Graduate School of Arts and Sciences.
For primary bibliographic entry see Field 4B.
W89-08262

FEASIBILITY STUDY OF THE PRIVATIZATION OF PUBLIC WASTEWATER TREATMENT WORKS,
Auburn Univ., AL. Dept. of Political Science.
J. G. Heilman, and G. W. Johnson.
Available from National Technical Information Service, Springfield, VA 22161, as PB89-155642/AS, price codes: A20 in paper copy, A01 in microfiche. Alabama Water Resources Research Institute, Auburn, Final Technical Completion Report, January 1989. 463p, 38 tab, 16 fig, 147 ref, 6 append. USGS contract 14-08-0001-G1288. USGS

project G-1288.

Descriptors: *Public-private partnerships, *Wastewater facilities, *Capital-intensive privatization, Feasibility, Public investment, Capital costs, Federal tax incentives, Financing, Legal aspects, Optimum development plans.

This report outlines the research and the results of a national feasibility assessment of capital-intensive privatization (CIP) of municipal wastewater works (WTW). The initial WTW CIP agreements, of which there were fewer than a dozen, were driven in part by federal tax incentives created in 1981 and 1982. These involved private sector financing, design, construction, operation, and ownership of WTW facilities. Tax reform in 1986 removed most of the tax incentives, but the water industry remains interested in developing the CIP option. In the post-1986 era, one agreement has been completed; others are in varying stages of development. Methods including case studies, mail and telephone surveys, document analysis, and aggregate data analysis were used to assess the legal, economic, political, and administrative feasibility of WTW CIP. The conclusion reached is that the WTW CIP option offers inherent efficiencies which are independent of tax incentives. WTW CIP is a feasible option which merits serious consideration by municipalities or other authorities planning to develop wastewater treatment capacity. WTW privatization raises many issues which must be recognized and addressed if accountability and the benefits of the efficiencies inherent in CIP are to be realized. These issues are identified and addressed in greater detail in order to provide information and guidance for authorities and policymakers considering privatization. (Warman-AL WRRI)
W89-08404

RENEWABLE ENERGY SOURCES AND VILLAGE WATER SUPPLY IN THE DEVELOPING COUNTRIES.
Commission of the European Communities, Luxembourg.
For primary bibliographic entry see Field 5F.
W89-08498

MANAGEMENT OF ORGANIC RESIDUALS SEPARATED FROM INDUSTRIAL WASTES,
Metropolitan Sanitary District of Greater Chicago, IL. Dept. of Research and Development.
For primary bibliographic entry see Field 5D.
W89-08715

WATER RESOURCES POLICY FOR ASIA.
For primary bibliographic entry see Field 6B.
W89-08899

REGIONAL WATER RESOURCES SITUATION: QUANTITATIVE AND QUALITATIVE ASPECTS,
Environmental Coordinating Unit, ESCAP, Bangkok, Thailand.
For primary bibliographic entry see Field 5G.
W89-08900

WATER RESOURCES DEVELOPMENT IN BHUTAN,
Ministry of Agriculture and Forest, Thimphu (Bhutan). Irrigation Section.
J. Dorgi, and A. K. Pradhan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 37-49, 1 tab.

Descriptors: *Water resources development, *Water management, *Water policy, *Bhutan, *Developing countries, *Agriculture, Hydroelectric power, Irrigation, *Economic aspects, Planning, Manpower, Regional development, Multiobjective planning, Alternative planning.

The Kingdom of Bhutan, a country richly endowed with water resources, must move rapidly and progressively to effectively develop and improve its agricultural base. There are many problems and constraints in the planning, development and management of water resources. Since Bhutan is a landlocked, mountainous country, many water resources studies and hydroelectric development face severe limitations in terms of accessibility and transportation. Other constraints include the lack of technical and administrative manpower, a lack of financial resources for development, and inadequate information resources concerning available land and water potential, alternatives for planning and operation of integrated multipurpose water resources projects, and international water laws and practices. The government is pursuing a national policy for planned multi-use development of its water resources. Under this program, cells will be required to carry out extensive investigations and planning studies for hydroelectric and irrigation projects. These cells will translate objectives into planning standards and criteria to formulate plans of development and to evaluate the consequences. The cells will also be competent to prepare final design and specifications for execution. The development of water utilization will continue to be of highest importance by orienting the planning policy of the country with the cooperation of neighboring countries and assistance from regional and international agencies. (See also W89-08899) (Sand-PTT)
W89-08901

WATER RESOURCES DEVELOPMENT IN CHINA,
Ministry of Water Resources and Electric Power, Beijing (China).
C. Jiaqi, and W. Guochang.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 51-60, 2 tab.

Descriptors: *Water resources development, *Water management, *Water policy, *Water pollution, *China, *Flood control, *Groundwater management, Industrial water use, Municipal water use, Water reuse, Agriculture, Irrigation, Water shortage, Rivers, Water storage, Reservoir storage, River basin development, Planning.

Guidelines and policies for water resources development and management in China should consider the following: 1. To improve management for existing projects of flood control, specific laws and regulations should be issued for preventing the river beaches and lakes that are to be used for flood routing, flood detention or flood storage from being encroached upon or ruined. 2. There should be a unified plan of development and management for surface water and groundwater. Reuse and recycling of industrial water use should also be improved. Municipal and industrial developments must be considered with conditions of flood control and water resources taken into account. 3. In drawing up plans for planting crops, water resources conditions should be considered so that best use can be made of water supply for agriculture to derive optimum results. It is also necessary to increase water storage capacity, including construction of new reservoirs. 4. Measures should be taken to prevent pollution and to protect forests and grasslands. 5. Administrative bodies at various levels should be set up for the management of rivers and lakes. (See also W89-08899) (Sand-PTT)
W89-08902

WATER RESOURCES DEVELOPMENT IN INDONESIA,
Small Tribes Organization of Western Washington, Sumner.
S. Ronodibroto.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 63-69.

Descriptors: *Comprehensive planning, *Water resources development, *Water policy, *Indonesia, *Developing countries, *Irrigation programs, *Water law, *Land reclamation, *Flood protection, Surface drainage, Reservoirs, Water management, Planning, Agriculture, Irrigation practices.

The objectives, priorities, and policy direction for Indonesia's National Development Plan for water resources are set out in the Five-Year Development Plan. This plan is an indicative plan and to a large extent encompasses development programs in the public sector. The following developmental approach has been established: 1. To develop and accelerate water resources while ensuring that the resources are not overexploited; 2. Rehabilitation and upgrading of the irrigation system to support the agricultural intensification programs; 3. Development of small, medium-sized irrigation schemes which are quick-yielding and where landowners are motivated and responsive to this form of development; 4. Development of tidal and nontidal swamps is to be continued using simple techniques which will be gradually improved; 5. Phased development in irrigation and reclamation planning so that immediate benefits can be obtained by the farmers at the end of each phase; 6. Accelerated river improvement and flood protection and surface drainage works program; 7. Rehabilitation, upgrading and new construction of surface water reservoirs; 8. Develop and improve water law and regulation. (See also W89-08899) (Sand-PTT)
W89-08903

WATER RESOURCES DEVELOPMENT AND MANAGEMENT IN MALAYSIA,
Drainage and Irrigation Dept., Kuala Lumpur (Malaysia).
D. N. Welch, and L. T. Keat.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 71-81, 3 fig.

Descriptors: *Comprehensive planning, *Water quality, *Water resources development, *Water management, *Water policy, *Malaysia, *Developing countries, *Agriculture, *Irrigation programs, Hydroelectric power, Flood control, Planning, Water pollution control, Flow control, Rivers, Industrial water, Public health, Environmental protection, Manpower, Technology.

Malaysia's water resources are abundant. However, there is a need for its proper management if the country is to be free of water resources constraints. Much of the water runs waste to the seas during the wet seasons and the quality of the remaining water is threatened by pollution. The current practice of piecemeal planning, development, and management of water projects without sufficient coordination, lacks overall control and has lead to inadequacies in existing laws and institutional framework. Malaysia's National Water Policy sets out proposals to overcome these shortcomings in the present water administration. This policy has the following specific objectives: 1. The maintenance of the requisite quantity of river flows in order to sustain normal water use and to preserve the quality of the environment; 2. The development of public water supply to a level necessary for improved social well-being of the people and to support industrial development; 3. The development of irrigation systems to attain the desired level of food self-sufficiency and to increase farm yield; 4. The development of hydropower to provide self-reliance in energy; 5. The abatement of water pollution from the standpoint of health and preservation of the environment; 6. The implementation of flood mitigation measures to protect the population and reduce flood damage. To implement these objectives a build-up of trained manpower and appropriate technology are essential. This is an area where Malaysia could enter into a meaningful program of cooperation with other countries. (See also W89-08899) (Sand-PTT)
W89-08904

WATER RESOURCES DEVELOPMENT IN NEPAL,
Water and Energy Commission, Kathmandu (Nepal).
S. P. Upadhyaya, and B. N. Sapkota.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 91-104, 3 tab.

Descriptors: *Irrigation projects, *Developing countries, *Sedimentation, *Multiobjective planning, *Water resources development, *Water policy, *Nepal, *Hydroelectric power, *Navigation, *Agriculture, *Flood control, Drought, Soil

erosion, Forestry, Wells, Tourism, Fish farming, Planning, Irrigation, Energy sources, Logging, Watershed protection.

Utilization of water resources in Nepal is constrained by several factors. Implementation of large irrigation projects requires appreciable financial resources; this has been a major impediment for development of these systems. Heavy sedimentation in river beds creates considerable problems in construction, operation, and maintenance of irrigation systems. Power to energize tubewells is severely restricted. Accelerated population growth has both increased the demand for fuelwood and led to forest clearance to provide land for agriculture. This type of extremely high pressure on land has increased the extent of flood and drought conditions. In addition, devegetation is causing serious soil erosion resulting in depression of agricultural productivity and imposing heavy costs on downstream areas through sedimentation and increased flooding. The broad policy framework for water resources development in Nepal is to develop these resources for multipurpose uses such as generation of hydroelectricity, irrigation, navigation, flood control and tourism. The policy outline of the Seventh Five-Year Plan in the water and agricultural sectors is centered around the following items: top priority is to be given to food production; development programs relating to farming, animal husbandry, poultry keeping, and fish farming; production of export-oriented and import substitution commodities; programs designed to increase employment and income; the distribution system for agricultural products; incentive prices for farm products; simple, practical and low-cost agricultural research; irrigation facilities; prevention of erosion, landslips, floods, etc., with emphasis on soil and watershed conservation; and improvement of the economic operation and maintenance of hydroelectric plants. (See also W89-08899) (Sand-PTT)
W89-08906

WATER RESOURCES DEVELOPMENT IN THE PHILIPPINES,
National Irrigation Administration, Quezon City (Philipines).
O. N. Cablayan, and M. R. Ticao.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 119-126.

Descriptors: *Management planning, *Interagency cooperation, *Water resources development, *Water management, *Philippines, *Developing countries, Agriculture, Navigation, Flood control, Watershed management, Conservation, Planning, Logging, Reforestation, Irrigation projects, Transportation, Crop yield.

There are a number of problems encountered in water resources planning, development, and management in the Philippines. Inadequate and inaccurate data has hindered the planning and development of water resources. The objection of people whose lands would be submerged have delayed several irrigation and reservoir projects. There are major conservation problems in watersheds including indiscriminate logging and poor land management. While reforestation rates have significantly increased in recent years, the planting of new trees is still not being done on an adequate scale. The recovery of costs of water resources projects, particularly for irrigation, is also a concern. The National Water Resources Council, in coordination with more than 20 ministries, government corporations and bureaus that are concerned with water resources development and usage, has implemented major projects including agriculture support facilities and services; irrigation, flood control and drainage; transport development, particularly roads, and where practicable ports and airports; health and education; and water supply facilities. Several monitoring systems have been developed and implemented with the following objectives: to monitor the flow and buildup of farm inputs before and during each cropping season and serve as an early warning system by detecting likely shortfalls so that timely action can be taken to ameliorate the situation; to monitor crop yields, farm profits, and changes in farm laborer employment and income; to account for the production and disposal of crops and for the distribution of income and other benefits; to recommend ways to maximize the project's benefit-generating capacity. (See also W89-08899) (Sand-PTT)
W89-08908

AGRO-SOCIO-ECONOMIC CONDITIONS IN BANGLADESH,
Bangladesh Inst. of Development Studies, Dacca.
M. Hossain.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 183-201, 10 tab, 4 ref.

Descriptors: *Crop production, *Water use, *Water resources development, *Bangladesh, *Developing countries, *Social aspects, *Economic aspects, *Resource allocation, *Irrigation programs, Flood control, Drainage, Planning, Public participation, Investment, Import, Technology, Agriculture.

Agricultural output in Bangladesh has lagged behind the growth of population over the long run. As a result, the country's dependence on food imports has increased. However, while some progress has been made over the last decade, with production growing at a rate of about 3% per annum, mostly due to some progress in the diffusion of new agricultural technology, this growth has created regional disparity and widened socio-economic inequality. Unequal distribution of agricultural income is inherent in the pattern of land distribution and in the operation of agrarian markets. Despite the moderate growth in per capita national income, rural poverty has worsened over time, as reflected in the consistently declining food and energy intake over the last two decades. Future growth must come from further diffusion of the new agricultural technology, for which a large potential exists. Acceleration of agricultural growth through more efficient exploitation of the potential will depend on large-scale public investment for development of irrigation, flood control, and drainage facilities and on agricultural research and extension. In allocating resources in these fields, more attention should be given to reducing regional disparity. (See also W89-08899) (Sand-PTT)
W89-08912

NATIONAL WATER GOALS, POLICIES, AND LAWS: THE INSTITUTIONAL FRAMEWORK,
Colorado State Univ., Fort Collins.
G. E. Radosevich.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 219-237, 4 fig, 19 ref.

Descriptors: *River basin development, *Water requirements, *Regional development, *Regional planning, *Water resources development, *Water management, *Water policy, *Policy making, *Water law, Decision making, Water allocation, Planning, Institutions, Social aspects, Political aspects, Economic aspects, Social costs, Water distribution.

The key ingredient to a successful national program of developing and managing water resources is the need and role of water resources policies at the national and/or provincial state and basin levels. This article focuses on the requirements for an appropriate institutional framework within which a successful implementation process can exist, 'institutional framework' referring to the policies, laws, organizations, and the process of implementation resulting from the allocation, distribution, management, and control of a nation's water resources. Experience gained in many countries and over many years of water resources research has shown that a good institutional arrangement is one that: (1) ultimately facilitates social choice; (2) reflects in some reasonable way 'political efficacy'; (3) facilitates decisions based on an understanding of the far-reaching consequences resulting from a mixture of social values and an expanded time horizon; (4) recognizes a decision-making process that takes into account the preferences and interests of those affected by the particular policy decisions; (5) produces decisions that are not only accepted as legitimate, but are also the result of a balance between what is desirable and what is acceptable; and (6) places some constraints on the losses or restrictions that it imposes on individuals and the cost required for its implementation. (See also W89-08899) (Sand-PTT)
W89-08914

SURFACE WATER POLICIES AND LAWS: THEIR ORIGINS AND ROLE IN PROMOTING EFFECTIVE WATER MANAGEMENT,
Melbourne Univ. (Australia).
S. D. Clark.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 239-265, 5 ref.

Descriptors: *Comprehensive planning, *Surface water, *Asia, *Water resources development, *Water law, *Water management, *Water policy, *Policy making, Decision making, Planning, Legislation, Southeast Asia, Water allocation, Political aspects, Interagency cooperation.

Since the mid-1960's there have been persistent calls for governments in Southeast Asia to revise both their administrative structures and water legislation in order to provide for proper development of cohesive, rational water management practices, proper planning procedures and techniques to determine the optimum means of implementing those policies, and appropriate administrative structures to ensure that water resources are managed and apportioned in efficient but equitable ways. Few countries, however, have fundamentally changed their legislation, and even where administrative and legislative changes have been made, performance persistently falls short of the goals. This failure is partly attributable to consultants, bureaucrats, and politicians. It has become necessary to devise new legislative mechanisms to ensure that requisite policy decisions are taken and not postponed or avoided, that policies, once enunciated, are in fact implemented by both ministers and bureaucrats, that requisite cooperation and coordination between agencies do occur in the formulation and implementation of policies, and that appropriate, defined planning procedures are observed by ministers and bureaucrats before decision are made. Recent legislation offers examples of how these results can be achieved. (See also W89-08899) (Sand-PTT)
W89-08915

SURFACE WATER STRATEGY, POLICIES, AND LAWS IN BANGLADESH,
Joint Rivers Commission, Dacca (Bangladesh).
M. A. H. Khan, and A. A. Khan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 267-284, 1 fig.

Descriptors: *Surface water, *Water resources development, *Water policy, *Water law, *Bangladesh, *Developing countries, International waters, Economic aspects, Ecological effects, Water shortage, International agreements, Optimum development plans.

Water resources in Bangladesh are problematical from both a physical and economic point of view. Physically, the Bangladesh delta is undergoing rapid ecological, hydrological, and morphological changes from both natural and man-made causes. Economically, the country is facing a dynamic water shortage as a result of increased demand for irrigation as well as the fact that water is becoming increasingly scarce. These problems are compounded by the absence of any effective water-sharing agreement of the international waters which cross the country. This has created a precarious environment which discourages investment in large scale-surface water projects and underlines the urgency of a comprehensive agreement of permanent sharing of water of all international rivers. Strategies and policies pursued by Bangladesh for the optimum utilization of surface water resources are analyzed and past achievements in the development of these resources are surveyed. The problems and potentials of harnessing surface waters

the legal framework for utilization of surface waters in Bangladesh is outlined. (See also W89-08899) (Sand-PTT)
W89-08916

SELECTED ISSUES OF GROUNDWATER MANAGEMENT,
New Mexico Univ., Albuquerque. School of Law.
For primary bibliographic entry see Field 4B.
W89-08917

GROUND WATER POLICIES: OPTIONS AND LAWS IN BANGLADESH,
Ministry of Agriculutre, Dacca (Bangladesh).
For primary bibliographic entry see Field 4B.
W89-08918

WATER QUALITY POLICIES AND LAWS: INTEGRATED CONTROL,
Washington Univ., Seattle. School of Law.
For primary bibliographic entry see Field 5G.
W89-08919

ROLE OF CUSTOMARY INTERNATIONAL WATER LAW,
International Association of Water Law, Rome (Italy). Executive Council.
D. A. Caponera.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 365-384, 37 ref.

Descriptors: *Water resources development, *Water law, *International law, *International waters, Water rights, Riparian rights, Negotiations, Water supply, Water quality, International agreements.

General principles and rules of customary international law of fresh water resources play a very important role when there is no agreement governing the relations of states sharing an international river, lake, or drainage basin. This article traces the history of the rules and principles of international water resources law that have evolved through the practice of states in their mutual, water-related relations. The present state of general international law on shared water resources development, conservation, and use can be summed up by three key principles: (1) Duty Not to Cause Substantial Injury. States sharing an international watercourse or basin are under obligation not to cause each other substantial injury, in regard to both water quantity and quality. (2) Right to an Equitable and Reasonable Share in the Utilization of the Waters of an International Watercourse or Basin. Subject to the overreaching principle mentioned above, states sharing an international watercourse or basin have the right to use the waters therein. This right being an attribute of sovereignty, each sharing state's own right is equal to the right of the other sharing states. When the circumstances are such that all the sharing states' equal rights cannot be satisfied to their full extent, some adjustment or accommodation is necessary. (3) Duty to Inform, Consult, and Engage in Good Faith Negotiations. The fundamental duty of states to refrain from using the waters of an international river, lake, or basin in such a way as to cause appreciable harm to another state on the same watercourse or in the same basin entails in practice that states must inform one another in advance of water development plans and projects which may have an appreciable detrimental impact on their respective interests. Both proposing and objecting state are under a duty to engage in good-faith negotiations with a view to finding a suitable accommodation of their respective interests. (See also W89-08899) (Sand-PTT)
W89-08921

ISSUES RELATING TO THE USES OF INTERNATIONAL WATER RESOURCES AND WORLD BANK PRACTICES,
Ministry of Finance and Planning, Dacca (Bangladesh). External Resources Div.
M. Munir-uz-Zaman.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 385-392, 6 ref.

Descriptors: *Water resources development, *Water law, *International law, *International waters, *International commissions, *Water policy, Riparian rights, International Bank for Reconstruction and Development, United Nations, Water allocation.

The international community over the years has succeeded in framing certain principles governing the uses of international water resources among the riparian states. Most significant works in this regard have been undertaken by the Institute of International law, Afro-Asian Legal Consultative Committee, and International Law Association which produced what is commonly known as the Helsinki Rules and International Law Commission of the United nations. Recently, the World Bank has reviewed the issues relating to the Bank's policy on riparian rights. The Bank has been financing a number of irrigation projects and is concerned with the prior settlement of all legal issues with regard to such projects so that future complications, legal or political, do not arise after the project has been implemented. A Staff Paper issued by the World Bank in 1985 reviews the Bank's policy on the development of international watercourses and summarizes international law practices with respect to the use and apportionment of international water by riparian states and also presents recommendations for the Bank's policy with respect to the development of international watercourses. (See also W89-08899) (Sand-PTT)
W89-08922

INTERNATIONAL WATER TREATIES: UNITED STATES AND MEXICO,
International Boundary and Water Commission, El Paso, TX.
J. F. Friedkin.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 393-414, 27 ref.

Descriptors: *Water resources development, *Water law, *International law, *International waters, *Treaties, *Water rights, *International agreements, *Mexico, *International commissions, *Rio Grande River, Riparian rights, United States, Water allocation, Flood control, Colorado River, Salinty.

During the past 100 years, serious international problems and issues have arisen over the control and use of the limited water supply of the boundary rivers between the United States and Mexico. These have been resolved in a series of treaties and related agreements and by their implementation through the International Boundary and Water Commission established by treaty in 1889. The treaty of 1906 provided for apportionment between the two countries of the waters of the Rio Grande in the uppermost reach of this boundary river, above Fort Quitman, Texas. An agreement reached in 1932 provided for joint plant for coordinated flood control works in the lower reaches of the Rio Grande. The 1933 Convention provided for joint works to stabilize the river boundary and control floods in the upper reach. The 1944 Water Treaty provided for apportionment of the waters in the boundary reaches of the Rio Grande downstream from Fort Quitman, and of the waters of the Colorado River. This treaty provided for joint construction, operation, and maintenance of international storage dams and other works needed on the Rio Grande to enable each country to utilize its allotted shares of the waters. Agreement was reached in 1965 to improve the salinity of the waters of the lower Rio Grande. Another agreement was reached in 1973 for a solution of the international water problem which arose as to the salinity of the lower Colorado River. Case studies are discussed for each of the water treaties and agreements, beginning with the questions, problems, and issues that have arisen between the two countries over the waters of the boundary rivers that required resolution, the principal provisions of each treaty, and their implementation. (See also W89-08899) (Sand-PTT)
W89-08923

NON-NAVIGATIONAL USES OF THE WATERS OF INTERNATIONAL RIVERS: WORK OF THE INTERNATIONAL LAW COMMISSION,
United Nations, New York. Div. of Water and Energy.
M. E. Solanes.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 415-429, 12 ref.

Descriptors: *Water resources development, *Water law, *International law, *International commissions, *International waters, Administrative agencies, Water rights, Riparian rights, International agreements, Water allocation, Water conservation, Water management.

International rivers pose complicated and often conflicting questions related to the development, use, and conservation of their waters. At the international level there is no supranational jurisdiction that could be imposed on a sovereign state, unless it has been previously agreed upon. Further complicating the problem has been a limited consensus on the substantive rules governing the use, allocation, development, and conservation of the waters of international watercourses. The role of the International Law Commission is to formulate a set of principles and rules for the use, development, conservation, and management of international watercourses, fulfilling several interrelated functions: (1) the codification and progressive development of international law; (2) the settling of 'residual' principles and rules to govern those elements of international watercourse law (except for navigation) which are not covered or dealt with comprehensively by international agreements in force; (3) provision of principles and foundations for the promotion and conclusion of agreements between states riparian to the same watercourse; (4) assisting in the interpretation of the provisions or terms of art used in provisions or in systems agreements. (See also W89-08899) (Sand-PTT)
W89-08924

IMPLEMENTING WATER RESOURCES POLICIES: SOCIAL CONSIDERATIONS,
Colorado State Univ., Fort Collins. Dept. of Sociology.
E. C. Vlachos.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 433-457, 1 fig, 13 ref.

Descriptors: *Water resources development, *Water policy, *Planning, *Water management, *Social aspects, Institutional constraints, Water supply, Water quality, Water use, Administration, Economic aspects.

As part of an integrated social system the use of water must be socially controlled through sets of institutions. The way in which water supply, patterns of water distribution, aspects of water quality, and water reclamation or reuse practices are regulated in a society will depend on the nature, structure, and evolution of its particular water system as affected by the larger socio-cultural environment and by the specific ecological circumstances of a given region. Despite the great variety between different water resources systems in their scope, extent, and organizational form, all systems encompass common elements and mechanisms which result from these basic questions: (1) how will the water resources be used in the productive process; (2) who will plan and how will the production facilities be installed and organized; (3) which individuals or groups will exercise control over the acquisition, distribution, use, and reclamation of water resources; (4) what will be the distribution and marketing of goods and services produced, including the installation and operation of distribution facilities. This article outlines these socio-cultural considerations concerning the relationship between water and society, as well as the larger institutional and organizational arrange-

ments for integrated water resources management. (See also W89-08899) (Sand-PTT)
W89-08925

ECONOMIC CONSIDERATIONS AND ALTERNATIVES IN WATER POLICY FORMULATION FOR BANGLADESH,
PATC, Dhaka, Bangladesh.
For primary bibliographic entry see Field 6B.
W89-08926

TECHNICAL CONSIDERATIONS IN WATER POLICY FORMULATION AND IMPLEMENTATION,
Utah Agricultural Experiment Station, Logan. International Irrigation Center.
For primary bibliographic entry see Field 6B.
W89-08927

MEKONG PROJECT: AN EXERCISE IN REGIONAL COOPERATION TO DEVELOP THE LOWER MEKONG BASIN,
Mekong Committee, Bangkok (Thailand).
For primary bibliographic entry see Field 4A.
W89-08928

INTERNATIONAL WATER RESOURCES LAW IN THE INDUS BASIN,
International Association of Water Law, Rome (Italy). Executive Council.
D. A. Caponera.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 509-515, 4 ref.

Descriptors: *Water resources development, *Water rights, *Riparian rights, *Water law, *International waters, *International law, *International agreements, *Treaties, *India, *Pakistan, *Indus River, Equitable apportionment, Information exchange, International commissions.

This article traces the history of the water dispute between India and Pakistan over the utilization of the Indus Basin from the Partition (1947) to the Indus Waters Treaty (1960). The agreement of the Indus Waters Treaty hinges on (1) an equitable apportionment of supplies which, by virtue of the agreement, would be increased well above the preagreement levels of availability; (2) detailed stipulations on the prior notification of proposed changes in the status quo reflected in the agreement, and on the periodic exchange of data; and (3) the continuity of the agreed-upon institutional arrangement in the Permanent Indus Commission. The Indus Waters Treaty and the Permanent Indus Commission support the basic observation that, no matter how prohibitive the circumstances of the case may be, an agreement can be made if the mutual advantages of agreed-upon water resources development outweigh the benefits of separate development. The Indus basin question also illustrates the favorable influence that international assistance and financing may have for the solution of vital water conflicts. (See also W89-08899) (Sand-PTT)
W89-08929

AGREEMENT ON THE GANGES,
B. M. Abbas.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 517-538.

Descriptors: *Water resources development, *Water rights, *Riparian rights, *International waters, *International agreements, *Treaties, *Ganges River, *India, *Bangladesh, *River basin development, *Water management, *Resource allocation, Irrigation, Drainage, Flood control, Hydroelectric power, Watershed management, Navigation, Flood control, Water use, Negotiations, Bramaputra River, Equitable apportionment, Interbasin transfers, Optimum development plans.

The history of negotiations between India and Bangladesh over the use of the resources of the Ganges River illustrates a classic upstream vs. downstream situation. Bangladesh proposed conservation of the excess monsoon flow through storage in the Ganges basin in India and Nepal. India proposed transferring water instead from the Brahmaputra river. Each side rejected the other's proposal. The stalemate has resulted from the two sides' very different approaches to water resources management in this instance. Bangladesh, as the downstream riparian, upholds the drainage basin concept and the principle of equitable apportionment. India's approach is the antithesis of the drainage basin concept. India views the Ganges and Brahmaputra rivers as segments of an eventual national water grid linking all the major rivers of northern and western India, wherein waters may be diverted out of their natural drainage basins. The key to the solution of the problem is integrated river basin development. The long-term objective should be the optimum development of the water resources of the river basins. Such a plan should provide a broad outline for the harmonious development of the various works in relation to all the reasonable possibilities of the basin. These include irrigation and drainage, hydroelectric power, navigation, flood control, watershed management, and industrial and domestic uses of water. The entire river basin should be treated as one unit and its water as the property of all the people living in the basin, to be equitably allocated taking into account the availability of water, the requirements of the different areas, and their ecological needs. (See also W89-08899) (Sand-PTT)
W89-08930

TOWARD A NATIONAL WATER PLAN IN BANGLADESH,
National Water Plan of Bangladesh, Dacca.
M. Chaudury, and M. H. Siddigi.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 549-580, 2 fig, 7 tab.

Descriptors: *Water resources development, *Water policy, *Planning, *Economic growth, *Resources management, *Bangladesh, *Developing countries, *Agriculture, *Fisheries, *Water supply development, Navigation, Domestic water, Industrial water, Flood control, Irrigation, Salinity management, Multiobjective planning, Priorities, Regional development.

The National Water Plan of Bangladesh has been established with the objective of maximizing the net value added in agriculture and fisheries, thus making the greatest possible contribution to economic growth, and to provide adequate water supplies in time and quantity for domestic and industrial users, navigation, salinity control, and environmental management. Since the plan has multiple objectives that are potentially conflicting, it is necessary as part of the planning process to rank the different objectives of the plan in order of priority and to take account of any conflicts or complementarities among objectives. This is done in the planning process by specifying one primary objective and then by imposing a number of constraints on that main objective which include: resource availability; the water supplied by other users (i.e. water supply for domestic and industrial users, navigation, environmental management, etc.); the fresh water required for salinity control in the lower delta; regional balance in investment and economic development; and institutional, organizational and human capabilities. The plan provides a perspective that unifies national concerns and interests, permitting the adjustment and improvement of the legal and institutional framework within which water resource management activities are carried out. The plan thus provides a technical and policy framework for successful local initiatives, in addition to those of the central authority to plan and implement water resources development projects in response to local and regional problems and needs. (See also W89-08899) (Sand-PTT)
W89-08932

WATER USER ORGANIZATIONAL NEEDS AND ALTERNATIVES,
National Irrigation Administration, Quezon City (Philipines).
For primary bibliographic entry see Field 3F.
W89-08933

NSF STANDARD AND CERTIFICATION PROGRAM FOR PLASTICS PIPE: STANDARD 14,
National Sanitation Foundation, Ann Arbor, MI.
For primary bibliographic entry see Field 8G.
W89-08974

CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS (40 CFR PART 258). SUBTITLE D OF RESOURCE CONSERVATION AND RECOVERY ACT (RCRA). BACKGROUND DOCUMENT: UPDATED REVIEW OF SELECTED PROVISIONS OF STATE SOLID WASTE REGULATIONS,
NUS Corp., Rockville, MD.
For primary bibliographic entry see Field 5E.
W89-09050

SETTING PRIORITIES: THE KEY TO NONPOINT SOURCE CONTROL,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 5G.
W89-09078

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1987,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W89-09205

6F. Nonstructural Alternatives

SPECIAL FLOOD HAZARD EVALUATION REPORT: MAUMEE RIVER, HENRY COUNTY, OHIO.
Army Engineer District, Buffalo, NY.
For primary bibliographic entry see Field 4A.
W89-08535

FUTURE FLOOD RESEARCH AGENDA FOR THE UNITED STATES,
Illinois State Water Survey Div., Champaign.
S. A. Changnon.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 17-25, 1 fig, 1 tab, 3 ref. Grants NSF-PAG-81-17017 and NSF-ATM-8413043.

Descriptors: *Flood control, *Research priorities, Flood plain management, Data collections, Information systems, Nonstructural alternatives, Flood damage.

Flooding remains a major unresolved problem in the United States with losses mounting after 60 years of largely structural efforts to mitigate loss. Hence, a major 2-year assessment of research needs to more effectively address flood mitigation was conducted within the context of our national shift to new federalism, the National Flood Insurance Program, the shift of emphases from structural to nonstructural approaches for flood mitigation, and the evolution in national programs of emergency assistance where flooding is but one of many hazards treated. Recommendations for research centered around six general themes: (1) more attention to socio-economic-political research; (2) the program should have a goal of efficient use of flood-prone lands, not loss reduction; (3) interdisciplinary research is essential with 70% of all 115 recommended tasks being multi-disciplinary; (4) the need to develop comprehensive data banks and flood information centers; (5) future research needs to be oriented to user needs; and (6) there is a need for continuing re-assessment of flood research every three years. (See also W89-08863) (Author's abstract)
W89-08865

FLOOD PLAIN MANAGEMENT: THE NZ EXPERIENCE,
Ministry of Works and Development, Wellington (New Zealand).
J. H. Lawrence, and P. Koutsos.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 347-368, 9 fig, 7 ref.

Descriptors: *New Zealand, *Flood plain management, *Interagency cooperation, Flood damages, Flood control, Flood protection.

The New Zealand experience with flood plain management is described in terms of the nature of the flood problem, the features of New Zealand's flood plain management system which are unique, because of the direct links between government technical and planning agencies and the strong ties between central and local government. The future directions are set out as a unified flood-loss reduction program based on New Zealand conditions and needs and what has been learned from the experience of other nations. (See also W89-08863) (Author's abstract)
W89-08893

6G. Ecologic Impact Of Water Development

DESCRIPTION AND EVALUATION OF THE EFFECTS OF URBAN AND AGRICULTURAL DEVELOPMENT OF THE SURFICIAL AQUIFER SYSTEM, PALM BEACH COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-08312

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
B. B. Bigelow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-719, 1988. 15p, 9 fig, 4 tab.

Descriptors: *Data collections, *Hydrologic data, *Dam effects, *Streamflow, *Alaska, *Valdez, Powerplants, Penstocks, Diversion structures, Fish hatcheries, Flow characteristics, Stream discharge.

In 1981, the Alaska Power Authority completed construction of a dam and spillway at the north end of Solomon Lake near Valdez. Regulation and diversion from the dam since 1962 have significantly altered the natural flow characteristics of Solomon Gulch. In September 1986, the Geological Survey began data collection to determine mean daily discharge at four sites below Solomon Lake and thus document the effects of regulation and diversion of water on the flow at various points in the system. Periodic discharge measurements and continuous records of water stage were obtained at two of the sites, and daily discharge values were computed for all four sites. The report contains descriptions of the data collection sites and the discharge records for each site for September 1986 and water year 1987. (Author's abstract)
W89-08458

JONGLEI CANAL: IMPACT AND OPPORTUNITY.
Cambridge University Press, Cambridge. 1988. 537p. Edited by Paul Howell, Michael Lock and Stephen Cobb.

Descriptors: *Canals, *Sudan, *Channeling, *Ecological effects, *Wetlands, *Economic aspects, *Social impact, *Water resources development, Nile River, Swamps, Irrigation, Hydrological regime, Jonglei Canal.

The vast of swamp and wetlands of the Southern Sudan, the Sudd, absorbs and dissipates by evaporation about half the inflow from the upper catchment of the White Nile. Ways and means of reducing these losses by canalization have been under engineering investigation since the beginning of the century, the objective being to provide additional water for irrigation and hydroelectric power in Egypt and the northern Sudan. Construction of the Jonglei Canal began in 1977; at the end of 1983 it was halted by civil war, 260 km from its outfall and 100 km short of completion. In the area through which it passes it will, if completed, have varied local effects; it will reduce the seasonally river-flooded grasslands which are of crucial importance to the pastoral sector of the local economy and cut the line of seasonal migration of man, livestock and wildlife. Yet it will bring the benefits and opportunities as well as adverse effects. It will divert at least the peak of the highest flows which have caused so much flood damage in the area in recent times, convey permanent water to a region which is dry for half the year, and provide a shorter and improved line of communication between north and south. Based on scientific studies of the area carried out in the early 1950s and again between 1977 and 1983, the aim of the book is to present a multi-disciplinary survey of the very complex interrelated hydrological, ecological, biological and human problems involved. It is not only a case study in which most problems of rural development and project management are present, but is intended also to provide a foundation upon which further research can proceed with minimum delay should political circumstances allow work on the canal and development of the area to begin again. (Lantz-PTT)
W89-08466

ENVIRONMENTAL ASSESSMENT OF THE POTENTIAL EFFECTS OF AQUIFER THERMAL ENERGY STORAGE SYSTEMS ON MICROORGANISMS IN GROUNDWATER,
Battelle Pacific Northwest Labs., Richland, WA.
R. J. Hicks, and D. L. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as DE88-007314, price codes: A04 in paper copy, A01 in microfiche. Report No. PNL--6492, March 1988. 53p, 2 tab, 101 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Legionella bacteria, *Ecological effects, *Aquifers, *Microbiological studies, *Groundwater pollution, *Thermal water, Bacteria, Porosity, Hydrogen ion concentration, Adsorption, Water temperature, Nutrients.

The primary objective of the study was to determine the potential effect (both adverse and beneficial) ATES (aquifer thermal energy storage) systems have on microorganisms inhabiting aquifers. The organisms of interest included both those microorganisms indigenous to aquifers, as well as those allochthonous microorganisms that enter aquifers and are able to survive there. The allochthonous microorganisms of particular concern were the Legionella bacteria. These organisms are ubiquitous in aquatic environments and can cause serious infections in humans. Some of the environmental factors that appear to have a strong effect on microbial activity in groundwaters include porosity, adsorption, nutrient availability, redox conditions, pH, and temperature. Heat systems may prohibit both the indigenous microbiota and pathogenic organisms from entering the aquifer. While the suppression of pathogenic organisms is favored, the loss of important degradative activities of indigenous microbiota would adversely affect the environmental quality of groundwater by increasing the residence times of contaminants at those locations where contaminants are present. Chill systems do not appear to inhibit the survival of indigenous microorganisms, although their activities would probably be suppressed. An issue of greater importance is the possibility of increased pathogen survival in these systems, especially of Legionella spp. These organisms have been associated with cooling towers and cold waters, such as those found in chill ATES systems, and their survival (though not their level of activity) is improved with decreasing temperatures. If adverse effects arise (i.e., increased pathogen survival and release) following the implementation of ATES technology, it is possible to treat the process waters chemically to destroy the pathogens of interest. (Lantz-PTT)
W89-08513

BIOLOGICAL INVESTIGATIONS OF THE BLACK CREEK VICINITY, BISCAYNE NATIONAL PARK,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
A. M. Szmant.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-213707. Price codes: A04 in paper copy, A01 in microfiche. National Park Service Research/Resources Management Report SER-87, December 1987. 61p, 3 fig, 6 tab, 1 ref, append. National Park Service Contract CX5000-4-1096.

Descriptors: *Sea grasses, *Estuarine environment, *Biological studies, *Aquatic plants, *National Parks, Black Creek, Ecological effects, Salinity, Color, Nutrients, Phytoplankton.

Biscayne National Park sought to determine whether there had been a shift in floral composition of the grassbed communities within the Black Creek area of the park, and if so, what might be the factors responsible for the changes in floral composition. Specifically, the National Park Service was concerned that Thalassia was being replaced by Halodule in certain affected areas. The study found lower water column salinities, higher water column nutrient concentrations, and more intense water color (brown tannins) in the affected areas where Thalassia was being replaced by Halodule. The likely source for these nutrients, salinity, and color anomalies is discharge water from the various drainage canals in the area from Military Canal to Fender Point. (Author's abstract)
W89-08533

CANAL DISCHARGE IMPACTS ON BISCAYNE BAY SALINITIES, BISCAYNE NATIONAL PARK,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2L.
W89-08540

INLAND WATERWAYS: PROCEEDINGS OF A NATIONAL WORKSHOP ON THE BENEFICIAL USES OF DREDGED MATERIAL.
For primary bibliographic entry see Field 5E.
W89-08555

AQUATIC HABITAT DEVELOPMENT ON THE TOMBIGBEE RIVER, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5E.
W89-08556

AQUATIC HABITAT CREATION ON THE OHIO RIVER, WITH REGULATORY CONSIDERATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5E.
W89-08557

RESULTS OF SALMONID FISH HABITAT RESTORATION WITH DREDGED MATERIAL IN THE CAMPBELL RIVER ESTUARY, BRITISH COLUMBIA, CANADA,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5E.
W89-08558

DREDGED MATERIAL PLACEMENT IN THE LITTORAL ZONE AT LAKE OF THE WOODS, NORTHWESTERN MINNESOTA,
Army Engineer District, St. Louis, MO.

For primary bibliographic entry see Field 5E.
W89-08559

UPLAND HABITAT DEVELOPMENT ON DREDGED MATERIAL PLACEMENT SITES, UPPER MISSISSIPPI RIVER, POOL 18,
Army Engineer District, Rock Island, IL.
J. R. Duyvejonck.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 120-128, 2 tab, 3 ref.

Descriptors: *Spoil disposal, *Spoil banks, *Ecosystems, *Dredging, *Mississippi River, *Revegetation, *Case studies, Water resources development, Vegetation, Hardwood, Waste disposal, Vegetation establishment, Grasses, Habitat development, Mulching, Topsoil, Bottomland.

Disposal of dredged material from Mississippi River 9-ft channel maintenance activities is a problem biologists and engineers have been attempting to solve for several years. In the past, and less frequently today, material often was placed in bottomland hardwoods in a permanent stockpile. Characteristically, most trees buried to a depth of more than 6 ft died within 1 to 2 years, leaving a sterile, unvegetated sand mound. Natural revegetation (succession) of these sandpiles is extremely slow or nonexistent. Some sites that were used only once in the 1940's and 1950's still remain mostly devoid of vegetation. Although these sand piles provide important recreational benefits, it is desirable that some of these sites be revegetated to replace habitat lost from disposal. Since 1981, experiments have been done with various planting techniques that can be used to readily establish a vegetative cover on these sites. Study objectives were to: (1) develop a method that uses a minimum of mechanized equipment and that can be used in inaccessible locations such as river islands; (2) develop 'foolproof methods' that could be implemented by anyone with a minimum of instruction; (3) ultimately revegetative sites with native species that provide food and shelter for wildlife; and (4) develop a variety of revegetation methods that can be used to meet the characteristics or management objectives of a particular site. Results of these field tests, and other experiments not discussed in this paper, indicate that if any seeding of coarse-grained sediment is to be successful, a mulch of some type is mandatory. As beneficial as mulches are, they do very little to actually improve the fertility of the sandy dredged material. This is why the incorporation of even a small amount of topsoil appears to greatly enhance the rapid establishment of native grass stands. The benefits of adding topsoil come at a higher cost/acre, and this technique is not practical for all sites. Locating a suitable nearby borrow source of topsoil is a frequent problem. (See also W89-08555) (Lantz-PTT)
W89-08560

WETLAND AND UPLAND WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL DISPOSAL AREAS ON THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
D. R. Hartley.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 129-133.

Descriptors: *Spoil disposal, *Spoil banks, *Inland waterways, *Wildlife habitats, *Wetlands, *Dredging, *Waste disposal, *Ecological effects, Wildlife management, Water resources development, Habitat development.

The Tennessee-Tombigbee Waterway (TTWW) is a 234-mi navigation link between Pickwick Lake on the Tennessee River and Mobile Bay, via the Tombigbee, Alabama, Black Warrior, and Mobile Rivers. There are ten locks and dams and three main sections, the river, canal, and divide. The TTWW was authorized in 1946; construction was begun in 1970, and it was completed in 1985. The TTWW was the most environmentally scrutinized public works project the Corps of Engineers has ever built. Mitigation in the TTWW is intensive management of 72,500 acres of project land for fish and wildlife, 14,000 acres of which are in disposal sites. Dredged material management is a significant part of the mitigation work. When disposal areas for dredged material on the TTWW were sited, location was given careful consideration. A number of the disposal areas were designed to be used only during construction and not for maintainance dredging. There are number of disposal sites that were used in construction that will also be used for maintenance dredging. Work with these areas is conducted to establish and maintain upland or wetland habitat. TTWW is managed very carefully and intensively for nongame and game species. Since public hunting use of these lands is allowed, more emphasis sometimes seems to be on the game, but this is not really the case. Wildlife and resource managers in the Mobile District do a balancing act because that is what gets the best results for all species of wildlife on the disposal areas. These disposal areas will be continued to be used for maintenance dredging. However, between dredging cycles, much of wildlife management can be accomplished. (See also W89-08555) (Lantz-PTT)
W89-08561

HABITAT MANAGEMENT FOR INTERIOR LEAST TERNS: PROBLEMS AND OPPORTUNITIES IN INLAND WATERWAYS,
Missouri Dept. of Conservation, Columbia.
J. W. Smith, and N. P. Stucky.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 134-149, 4 fig, 21 ref.

Descriptors: *Flood control, *Management planning, *Wildlife habitats, *Wildlife management, *Water birds, *Mississippi River, *Ecological effects, *Flood control, *Aquatic habitats, *Inland waterways, *Channel improvement, Birds, Mississippi River, Water resources development Channels, Water resources management, Dredging, Terns, Interagency cooperation, Multiobjective planning.

The interior population of the least tern (Sterna antillarum) was added to the Federal Endangered Species List in 1985. Concern for the long-term survival of the least tern is primarily habitat related; much of the riverine island and sandbar habitat historically used by interior least terns has been lost or modified by impoundment, channelization, and bank stabilization projects designed to achieve flood control and navigation objectives. Since 1985, the Missouri Department of Conservation (MDC) has been involved in an interagency least tern research program, funded in part with Federal Aid Funds administered by the Fish and Wildlife Services's Region 3 Office under Section 6 of the Endangered Species Act. This effort, which has included monitoring of Mississippi River least tern colonies in Illinois, Kentucky, Tennessee, and Missouri, has provided the basis for assessing the use and potential long-term availability of least tern nesting habitat in the Lower Mississippi River. The authors believe that modification of control structures hold tremendous potential for accomplishing both channel maintenance objectives and aquatic ecosystem enhancement. As an initial step, an interagency working group should be established for the Lower Mississippi River to identify and assess problems associated with multipurpose use. This approach has been used successfully on the Upper Mississippi River since 1973. Such a team, composed of State and Federal agencies with management responsibilities on the river, could work together to develop recommendations for improved multipurpose management of Lower Mississippi River resources, with special emphasis on the least tern. If by creating an island in a problem area, the self-maintaining capabilities of the river channel can be improved, and the future needs for dredging can be reduced, then everybody wins--the diversity of the aquatic ecosystem is not compromised, and the least tern stands to benefit from increased habitat availability. (See also W89-08555) (Lantz-PTT)
W89-08562

ESTABLISHMENT OF A NATIVE MIDWESTERN WETLAND PLANT COMMUNITY THROUGH RELOCATION OF MARSH TOPSOIL,
Army Engineer District, Chicago, IL.
For primary bibliographic entry see Field 4C.
W89-08563

UPPER MISSISSIPPI RIVER CHANNEL MAINTENANCE PLAN, BENEFICIAL AND PRODUCTIVE USE OF THE DREDGED MATERIAL,
Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 5E.
W89-08567

INNOVATIVE RECREATION AND COMMERCIAL USES OF DREDGED MATERIAL ON THE TENNESSEE-TOMBIGBEE WATERWAY,
Army Engineer District, Mobile, AL.
N. D. McClure.
IN: Inland Waterways: Proceedings of a National Workshop on the Beneficial Uses of Dredged Material. October 27-30, 1987, St. Paul, Minnesota. Technical Report D-88-8, November 1988. Final Report. p 201-208, 2 tab, 6 ref.

Descriptors: *Spoil disposal, *Inland waterways, *Dredging, *Water resources development, *Ecological effects, Wildlife habitat, Recreation, Disposal sites, Ecosystems, Case studies, Tennessee-Tombigbee Waterway.

The Tennessee-Tombigbee Waterway is a connecting link joining the well-established Tennessee River and Black Warrior-Tombigbee River Systems. The 234-mi waterway with its 10 locks and dams and 44,000 acres of water surface has the identified purposes of navigation, fish and wildlife conservation, recreation, and area redevelopment. An Environmental Impact Statement which culminated Phase I of the Continuing Environmental Studies recognized that disposal of some 300 million cubic yards of excess material represented a sizable challenge. An interdisciplinary team approach was utilized to site the disposal areas in a manner which avoided, to the extent practicable, the more valuable wildlife habitats and cultural resources. After siting the disposal areas utilizing false color infrared photography delineating habitat types, field siting efforts with a team of biologists, real estate specialists, and representatives of the Fish and Wildlife Service, were undertaken. The disposal area in the vicinity of the Columbus cutoff near Columbus, MS, graphically illustrates how this approach permitted the avoidance of important resources. The disposal area dike was aligned to preserve an Indian mound and the site was oriented to protect White's Slough, a valuable wetland habitat. (See also W89-08555) (Lantz-PTT)
W89-08568

OVERVIEW OF PAST AND POTENTIAL NATURAL RESOURCE BENEFICIAL USES OF DREDGED MATERIAL IN THE GREAT LAKES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5E.
W89-08569

OVERVIEW OF ALTERNATIVES FOR TOLEDO HARBOR, FOCUSING ON COMMERCIAL, AGRICULTURAL, AND UPLAND REUSE,
Toledo Metropolitan Area Council of Governments, OH.
For primary bibliographic entry see Field 5E.
W89-08570

BENEFICIAL USES OF DREDGED MATERIAL IN THE DEVELOPMENT OF TORONTO HARBOUR,

Environmental Protection Service, Toronto (Ontario). Ontario Region.
For primary bibliographic entry see Field 5E.
W89-08571

LAND USE ALONG THE TANA RIVER, KENYA--A STUDY WITH SMALL FORMAT AERIAL PHOTOGRAPHY AND MICROLIGHT AIRCRAFT,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 7B.
W89-08574

REMOTE SENSING AS A TOOL FOR ASSESSING ENVIRONMENTAL EFFECTS OF HYDROELECTRIC DEVELOPMENT IN A REMOTE RIVER BASIN,
Ontario Hydro, Toronto.
For primary bibliographic entry see Field 7A.
W89-08595

ENVIRONMENTAL ASSESSMENT FOR LARGE SCALE CIVIL ENGINEERING PROJECTS WITH DATA OF DTM AND REMOTE SENSING,
Hosei Univ., Tokyo (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 7C.
W89-08596

SEDIMENT DISCHARGE IN ROCK CREEK AND THE EFFECT OF SEDIMENTATION RATE ON THE PROPOSED ROCK CREEK RESERVOIR, NORTHWESTERN COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-08623

RECONNAISSANCE OF WATER QUALITY IN THE HIGH PLAINS AQUIFER BENEATH AGRICULTURAL LANDS, SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08631

POSSIBLE CHANGES IN GROUND-WATER FLOW TO THE PECOS RIVER CAUSED BY SANTA ROSA LAKE, GUADALUPE COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Risser.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4291, 1987. 79p, 38 fig, 1 tab, 33 ref.

Descriptors: *Surface-groundwater relations, *Water resources development, *Environmental effects, *Groundwater movement, *Santa Rosa Lake, New Mexico, Santa Rosa Dam, Dams, Pecos River, Hydrologic models, Simulation analysis, Hydrologic budget.

In 1980 Santa Rosa Dam began impounding water on the Pecos River about 7 miles north of Santa Rosa, New Mexico, to provide flood control, sediment control, and storage for irrigation. Santa Rosa Lake has caused changes in the groundwater flow system, which may cause changes in the streamflow of the Pecos River that cannot be detected at the present streamflow gaging stations. Data collected at these stations are used to measure the amount of water available for downstream users. A three-dimensional groundwater flow model for a 950 sq mi area between Anton Chico and Puerto de Luna was used to simulate the effects of Santa Rosa Lake on groundwater flow to a gaining reach of the Pecos River for lake levels of 4,675, 4,715, 4,725, 4,750, 4,776, and 4,797 feet above sea level and durations of impoundment of 30, 90, 182, and 365 days for all levels except 4,797 feet. These simulations indicated that streamflow in the Pecos River could increase by as much as 2 cu ft/sec between the dam and Puerto de Luna if the lake level were maintained at 4,797 feet for 90 days or 4,776 feet for 1 year. About 90% of this increased streamflow would occur < 0.5 mi downstream from the dam, some of which would be measured at the streamflow gaging station located 0.2 mile downstream from the dam. Simulations also indicated that the lake will affect groundwater flow such that inflow to the study area may be decreased by as much as 1.9 cu ft/sec. This water may leave the Pecos River drainage basin or be diverted back to the Pecos River downstream from the gaging station near Puerto de Luna. In either case, this quantity represents a net loss of water upstream from Puerto de Luna. Most simulations indicated that the decrease in groundwater flow into the study area would be of about the same quantity as the simulated increase in streamflow downstream from the dam. Therefore, the net effect of the lake on the flow of the Pecos River in the study area appears to be negligible. Model simulations indicated that effect of lake levels below 4,750 feet on water levels in observation wells completed in the San Andres Limestone could not be distinguished from the effects of other hydrologic stresses. (Author's abstract)
W89-08670

SYNOPSIS OF SALTWATER INTRUSION IN DADE COUNTY, FLORIDA, THROUGH 1984,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08718

HYDROLOGIC EFFECTS OF GROUND- AND SURFACE-WATER WITHDRAWALS IN THE HOWE AREA, LAGRANGE COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08742

GEOHYDROLOGY AND GROUND-WATER QUALITY ON SHELTER ISLAND, SUFFOLK COUNTY, NEW YORK, 1983-84,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08744

HYDROLOGIC EFFECTS OF GROUND- AND SURFACE-WATER WITHDRAWALS IN THE MILFORD AREA, ELKHART AND KOSCIUSKO COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08745

WATER-QUALITY APPRAISAL OF NASQAN STATIONS BELOW IMPOUNDMENTS, EASTERN TENNESSEE,
Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08750

SIMULATED EFFECTS OF PROJECTED PUMPING ON THE AVAILABILITY OF FRESHWATER IN THE EVANGELINE AQUIFER IN AN AREA SOUTHWEST OF CORPUS CHRISTI, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
G. E. Groschen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4182, 1985. 103p, 22 fig, 2 tab, 54 ref, append.

Descriptors: *Simulation analysis, *Groundwater availability, *Coastal aquifers, *Saline water intrusion, *Ecological effects, *Texas, Groundwater quality, Hydraulic conductivity, Evangeline Aquifer, Aquifers, Water pollution sources, Chlorides, Leakage, Groundwater irrigation, Groundwater pollution, Groundwater mining.

This study is an investigation of the continued availability of freshwater in the Evangeline aquifer along the Texas Gulf Coast and the potential for degradation of the water quality by saline water intrusion. Recharge to the aquifer occurs by the infiltration of precipitation in the outcrop area and by cross-formational flow from deeper aquifers. The pre-development recharge rate is about 6 to 8 cu ft/sec. Discharge, under natural conditions, is upward into the Chicot aquifer and to the Nueces River or Gulf of Mexico. Intensive pumping by irrigators, industries, and municipalities over the last 80 yr has created a cone of depression as deep as 219 ft below sea level under the city of Kingsville in Kleberg County. The total rate of pumpage in 1982 was 29.6 cu ft/sec. A mathematical model of the flow and water quality in the Evangeline aquifer was developed using available data to simulate the historical effect of pumping on the potentiometric surface and water quality, and to simulate the effect of projected pumping on the potentiometric surface and water quality to the year 2020. The water quality in the aquifer is only marginally suitable for drinking water. The chloride concentration before development in the 1930's and 1940's, ranged from 9 to 1,971 mg/L. The mean chloride concentration was 353 (standard deviation 262) mg/L. The potential sources of water quality degradation on a regional scale are: saline water intrusion from under the Gulf of Mexico; movement of poor quality water within outlying sections of the aquifer; and downward leakage from the overlying Chicot aquifer. Leakage from the Chicot is the most likely to cause serious regional water quality degradation. The simulations and the sensitivity tests of the aquifer properties, conditions, and assumptions indicate that vertical conductivity of the Chicot aquifer is the most sensitive and least well known part of the system. Two simulations of the projected pumping--a low estimate, as much as 46.2 cu ft/sec during 2011-20; and a high estimate, as much as 60.0 cu ft/sec during the same period--indicate that no further regional water quality deterioration is likely to occur. (Author's abstract)
W89-08807

LAND SUBSIDENCE IN THE SAN JOAQUIN VALLEY, CALIFORNIA, AS OF 1983,
R. L. Ireland.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4196, 1986. 50p, 40 fig, 1 tab, 31 ref.

Descriptors: *Subsidence, *Hydrologic data collections, *Groundwater depletion, *San Joaquin Valley, *Ecological effects, *Water resources development, *California, Land use, Groundwater movement, Surface water, Drought, Aquifers, Surface-groundwater relations, Water level.

Land subsidence due to groundwater withdrawal in the San Joaquin Valley that began in the mid-1920's and reached a maximum of 29.7 ft in 1981 has been halted by the importation of surface water through major canals and the California Aqueduct in the 1950's through 1970's. Water levels throughout most of the San Joaquin Valley have recovered to 1940-50 levels. Extensometer, water level, and subsidence data from this long-term subsidence study can be utilized to manage the groundwater basin so as to prevent serious future subsidence. Leveling by the California Department of Water Resources in 1981-82 showed a maximum land surface rebound of about 0.5 ft along the California Aqueduct from 1977-78 to 1981-82. This land surface rebound is directly related to the 1976-77 drought. Measured subsidence during the drought was mostly in the elastic range; only a small part was inelastic (permanent subsidence). Field extensometers confirm expansion of the aquifer system but the expansion was less than land surface rebound observed by the spirit leveling of bench marks. The computer program and extensometer and water level data collected on this long-term cooperative study on land subsidence are stored on

computer tape No. 220691, type 6250BPI, at the U.S. Geological Survey Information Services Division, Reston, Virginia. (Author's abstract)
W89-08819

SIMULATION OF THE EFFECTS OF MANAGEMENT ALTERNATIVES ON THE STREAM-AQUIFER SYSTEM, SOUTH FORK SOLOMON RIVER VALLEY BETWEEN WEBSTER RESERVOIR AND WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. D. Burnett, and T. B. Reed.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4200, 1985. 19p, 7 fig, 8 tab, 1 plate, 7 ref.

Descriptors: *Groundwater resources, *Simulation analysis, *Surface-groundwater relations, *Water resources development, *Water management, *Kansas, Solomon River, Phreatophytes, Surface water, Alluvial aquifers, Model studies, Irrigation effects.

With extensive irrigation use of both surface water and groundwater in the South Fork Solomon River valley shortages of these water supplies have been created. A two-dimensional digital model of transient groundwater flow was applied to investigate the potential effects on the stream aquifer system of seven management alternatives. These alternatives included proposals to conserve surface water supplies by lining the Osborne Irrigation Canal with clay, replacing the lateral canals with pipe, removing phreatophytes, decreasing surface water use by 75%, 50%, or 25% and replacing it with groundwater sources, and continuing 1978 groundwater use and 1970-78 average surface water use until the end of the 20th century. Results were assessed by comparison of drawdowns of hydraulic head in the alluvial aquifer and base flow for each simulation. As listed in order of the smallest to the greatest potential effects on the system relative to drawdown and base flow the alternatives are: (1) removal of one-half of the phreatophytes; (2) continuation of 1978 groundwater withdrawals and average 1970-78 surface water supply; (3) replacement of the lateral canals with pipe; (4) lining the Osborne Irrigation Canal with clay; (5) decrease of surface water use by 25% and replacement of it with groundwater; (6) decrease of surface water use by 50% and replacement of it with groundwater; and (7) decrease of surface water use by 75% and replacement of it with groundwater. The removal of one-half of the phreatophytes would result in a decrease in average drawdown in the alluvial aquifer to about 1.74 ft and an increase in base flow of the Solomon River to about 12.3 cu ft/sec. The decrease of surface water supply by 75% and a corresponding increase in groundwater withdrawal would result in an increase in drawdown in the aquifer to about 2.5 ft and a decrease in base flow to about 6.8 cu ft/sec. (Lantz-PTT)
W89-08823

SIMULATION ANALYSIS OF WATER-LEVEL CHANGES IN THE NAVAJO SANDSTONE DUE TO CHANGES IN THE ALTITUDE OF LAKE POWELL NEAR WAHWEAP BAY, UTAH AND ARIZONA,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08826

ESTIMATING ECONOMIC IMPACTS OF SALINITY OF THE COLORADO RIVER,
Milliken Chapman Research Group, Inc., Littleton, CO.
For primary bibliographic entry see Field 5C.
W89-08979

CHARACTER AND EVOLUTION OF THE GROUND-WATER FLOW SYSTEM IN THE CENTRAL PART OF THE WESTERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08999

POTENTIAL FOR AQUIFER COMPACTION, LAND SUBSIDENCE, AND EARTH FISSURES IN AVRA VALLEY, PIMA AND PINAL COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09001

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN EAST CARSON VALLEY, DOUGLAS COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09004

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN SOUTHEASTERN CARSON CITY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09005

EFFECT OF BANK PROTECTION MEASURES, STEHEKIN RIVER, CHELAN COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4D.
W89-09022

POTENTIAL HYDROLOGIC EFFECTS OF GROUND-WATER WITHDRAWALS FROM THE DAKOTA AQUIFER, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
K. R. Watts.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-567, 1985. 72p, 24 fig, 11 tab, 58 ref.

Descriptors: *Groundwater mining, *Environmental effects, *Dakota Aquifer, Groundwater level, *Model studies, *Kansas, Computer models, Simulation analysis, Leakage, Groundwater discharge, Hydraulic conductivity, Pumpage, Groundwater management.

A study was conducted to evaluate the effects of potential development of the Dakota aquifer on the layered aquifer system above Permian rocks in a 5,000 sq mi area of southwestern Kansas. Transmissivity of the Dakota aquifer, determined from analyses of pumping tests, ranges from 100 to 7,100 sq ft/day. Water in the Dakota aquifer is a calcium bicarbonate type water, similar to water in the High Plains aquifer, in the subcrop area. However, in areas distant from the subcrop, water in the Dakota aquifer is a sodium bicarbonate type water with dissolved solids concentrations in excess of 500 mg/L. Gradual declines in the potentiometric surface of the Dakota aquifer have occurred since the onset of pumpage in the 1960's; however, water levels in some wells have risen during the late 1970's. A digital computer model of 3-D groundwater flow was developed to simulate hydrologic conditions of a five-layer hydrologic system for 1975-82 conditions. The major components of the simulated 1975-82 water budget were well discharge from the High Plains aquifer and loss of ground water from storage in the High Plains aquifer. Although downward leakage from the High Plains aquifer in the study area represented only 18,000 acre-ft of the 1,365,000 acre-ft discharged from the High Plains aquifer during 1982, it was a major source of inflow to the Dakota aquifer. Changes in storage in the Dakota aquifer in the study area during 1982 were about 5,000 acre-ft. A base-line projection was made using 1982 simulated hydraulic heads from the calibrated model and 1982 rates of pumpage from both the High Plains and the Dakota aquifers for comparison with eight additional projection simulations in which maximum pumpage from the Dakota aquifer at the end of the projections ranged from about 78,000 to 294,000 acre-ft/yr. The results from the projections indicate that: (1) pumpage from the Dakota aquifer will have a limited effect on hydraulic heads in the High Plains aquifer, (2) drawdown in the hydraulic heads in the Dakota aquifer will result in conversion of much of the Dakota aquifer to unconfined conditions, (3) change in storage will become the major water-budget component for the Dakota aquifer, (4) continuation of 1982 rates of withdrawal from the High Plains aquifer will result in dewatering of a substantial part of the aquifer in the study area. (Lantz-PTT)
W89-09100

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE TULARE LAKE BED AREA, SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA, 1986-87,
Geological Survey, Sacramento, CA. Water Resources Div.
R. A. Schroeder, D. U. Palawski, and J. P. Skorupa.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4001, February 1988. 86p, 9 fig, 23 tab, 1 plate, 72 ref, 4 append.

Descriptors: *San Joaquin Valley, *Path of pollutants, *Agricultural runoff, *Environmental effects, *Tulare Lake, *Irrigation effects, *Selenium, *California, Sediment contamination, Water quality, Bioaccumulation, Pesticides, Trace element, Birds, Pesticides, Fate of pollutants.

Concentrations of numerous toxic trace elements and pesticides were measured during 1986 in water, sediment, and biota from three areas near the Tulare Lake Bed, southern San Joaquin Valley, California: Kern National Wildlife Refuge, Pixley National Wildlife Refuge, and Westfarmers evaporation ponds about 5 mi west of Kern National Wildlife Refuge, to determine whether toxic constituents in agricultural-irrigation drainage pose a threat to beneficial uses of water, especially to uses by wildlife. Pesticide residues were found to be low at all three areas. Trace element concentrations were found to be comparatively low at the Kern and Pixley National Wildlife Refuge areas and high at the Westfarmers evaporation ponds. Dissolved selenium concentrations were < 1 micrograms/L (ug/L) in areas on and adjacent to the refuges, but ranged from 110 to 360 ug/L in the saline drainwater impounded in the evaporation ponds. The ratio of mean selenium concentrations in biota from Westfarmers ponds compared to biota from Kesterson National Wildlife Refuge (where adverse effects have been documented) is 5 for waterboatman, 2 for avocet liver, 1 for avocet eggs, and < 1 for widgeongrass. The low concentrations measured at Kern and Pixley National Wildlife Refuges suggest that trace elements and pesticides pose little threat to wildlife there; however, impounded subsurface drainage from agricultural irrigation does pose a threat to wildlife at the nearby Westfarmers ponds. Preliminary results of surveys conducted in 1987 indicated that there are adverse biological effects on shorebirds nesting at the ponds, although interpretation of the magnitude of the effects is premature, pending completion of ongoing studies by the U.S. Fish and Wildlife Service. (Author's abstract)
W89-09142

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE MIDDLE GREEN RIVER BASIN, UTAH, 1986-87,
Geological Survey, Salt Lake City, UT. Water Resources Div.

D. W. Stephens, B. Waddell, and J. B. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4011, 1988. 70p, 12 fig, 19 tab, 53 ref.

Descriptors: *Path of pollutants, *Agricultural runoff, *Environmental effects, *Middle River, *Irrigation effects, *Utah, *Selenium, Fate of pollutants, Stewart Lake, Sediment contamination, Water quality, Bioaccumulation, Boron, Zinc, Water birds.

Reconnaissance of wildlife areas in the middle Green River basin of Utah was conducted during 1986 and 1987 to determine whether irrigation drainage has caused, or has the potential to cause significant harmful effects on human health, fish, and wildlife, or may adversely affect the suitability of water for beneficial uses. Studies at Stewart Lake Waterfowl Management Area and Ouray National Wildlife Refuge indicated that concentrations of boron, selenium, and zinc in water, bottom sediment, and biological tissue were sufficiently large to be harmful to fish and wildlife, and to adversely affect beneficial uses of water. Selenium is the principal element of concern in both areas. Concentrations of dissolved selenium in irrigation drain water entering Stewart Lake Waterfowl Management Area ranged from 14-140 micrograms/L (ug/L) and consistently exceeded Utah standards for wildlife protection in water in two of the four drains. Concentrations of boron and zinc exceeded Utah standards only occasionally in the drain waters. Concentrations of total selenium in sediments collected where the drains discharge into the lake were 10-85 ug/gm. Liver tissue collected from American coots at Stewart Lake Waterfowl Management Area contained concentrations of selenium from 4.9-26 ug/gm (dry weight), and whole body samples of carp contained as much as 31 ug/gm (dry weight). Concentrations of selenium in Potamogeton and blue-green algae ranged from 2.1-27 ug/gm. Concentrations of boron, selenium, and zinc were also measured in water from Ouray National Wildlife Refuge. Liver tissue of American coots from the North Roadside Pond, which receives irrigation tailwater, contained a geometric-mean concentration of selenium of 32 ug/gm (dry weight). Five water-bird eggs collected from the North and South Roadside Ponds contained selenium concentrations of 63-120 ug/gm (dry weight). (Lantz-PTT)
W89-09145

7. RESOURCES DATA

7A. Network Design

COST EFFECTIVENESS OF THE STREAM FLOW-GAGING PROGRAM IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. A. Druse, and K. L. Wahl.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4264, 1988. 35p, 3 fig, 5 tab, 20 ref.

Descriptors: *Cost-benefit analysis, *Gaging stations, *Network design, *Water resources data, *Operating costs, *Wyoming, Economic evaluation, Operating policies, Stream gages, Surface water records, Data collections.

This report documents the results of a cost-effectiveness study of the streamflow-gaging program in Wyoming. Regression analysis or hydrologic flow-routing techniques were considered for 24 combinations of stations from a 139-station network operated in 1984 to investigate suitability of techniques for simulating streamflow records. Only one station was determined to have sufficient accuracy in the regression analysis to consider discontinuance of the gage. The evaluation of the gaging-station network, which included the use of associated uncertainty in streamflow records, is limited to the nonwinter operation of the 47 stations operated by the Riverton Field Office of the U.S. Geological Survey. The current (1987) travel routes and measurement frequencies require a budget of $264,000 and result in an average standard error in streamflow records of 13.2%. Changes in routes and station visits using the same budget, could optimally reduce the standard error by 1.6%. Budgets evaluated ranged from $235,000 to $400,000. A $235,000 budget increased the optimal average standard error/station from 11.6 to 15.5%, and a $400,000 budget could reduce it to 6.6%. For all budgets considered, lost record accounts for about 40% of the average standard error. (USGS)
W89-08409

USE AND AVAILABILITY OF CONTINUOUS STREAMFLOW RECORDS IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
J. F. Lowery.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-322, 1988. 26p, 3 fig, 2 tab, 4 ref.

Descriptors: *Gaging stations, *Network design, *Surface water records, *Tennessee, Data uses, Station funding.

This report documents the results of the data uses and funding part of a study of the cost-effectiveness of the streamflow information program in Tennessee. Presently, 88 continuous surface water gaging stations are operated in Tennessee on a budget of $490,800. Data uses and funding sources are identified for each of the 88 stations. Data from most stations have multiple uses. (USGS)
W89-08429

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 2. DESIGN OF THE EMISSION INVENTORY: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
For primary bibliographic entry see Field 5B.
W89-08508

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
Proceedings of the Seventh International Symposium on Remote Sensing for Resources Development and Environmental Management ISPRS Commission VII, Enschede, 25-29 August 1986. Volume One. A.A. Balkema, Boston. 1986. 547p. Edited by M.C.J. Damen, G. Sicco Smit and H.Th. Verstappen.

Descriptors: *Aerial photography, *Remote sensing, *Data acquisition, *Mapping, Case studies, Environmental policy, Infrared imagery, Data interpretation, Sensors, Resources development, Resources management, Environmental engineering.

The proceedings of the symposium on remote sensing for Resources Development and Environmental Management The topics covered in Volume One of include visible and infrared data, microwave data, spectral signatures of objects, and renewable resources in rural areas. New and improved methods for remote sensing, and the aircraft suitable for these purposes, as well as data analysis techniques and case studies are discussed. These methods can be used for assessing water management techniques, land use, and crop conditions for large and/or inaccessible areas that can not be surveyed using conventional methods. (See W89-08573 thru W89-08577, W89-08609) (White-Reimer-PTT)
W89-08572

PHOTO-INTERPRETATION OF WETLAND VEGETATION IN THE LESSER ANTILLES,
Office National des Forets, Basse-Terre (Guadeloupe).
For primary bibliographic entry see Field 7B.
W89-08576

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
Proceedings of the Seventh International Symposium on Remote Sensing for Resources Development and Environmental Management, ISPRS Commission VII, Enschede, 25-29 August 1986. Volume Two. A.A. Balkema, Boston. 1986. 409p. Edited by M.C.J. Damen, G. Sicco Smit and H.Th. Verstappen.

Descriptors: *Aerial photography, *Remote sensing, *Mapping, *Data acquisition, Data processing, Data interpretation, Case studies, Hydrology, Geology, Geomorphology, Coastal zone management, Urban planning, Monitoring, Satellite technology, Environmental policy, Infrared imagery, Sensors, Resources development, Resources management, Environmental engineering.

Topics presented at the symposium on remote sensing for Resources Development and Environment Management included: Non-renewable resources (geology, geomorphology, and engineering projects); Hydrology (surface water, oceanography, coastal zone, ice and snow); Human settlements (urban surveys, human settlement analysis, and archaeology); and Geo-information systems. The use of remote sensing by means of satellites, aerial photography, infrared, etc. for mapping, monitoring, and assessing large areas is discussed. These techniques can be used for determining environmental impacts, delineation and classification of vegetation, flow characteristics, temperature gradients, and developing simulation models. (See W89-08578 thru W89-08609, W89-08572) (White-Reimer-PTT)
W89-08577

JRC PROGRAM FOR MARINE COASTAL MONITORING,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
J. A. Bekkering.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enchede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 699-702, 2 tab, 1 fig, 19 ref.

Descriptors: *Model studies, *Remote sensing, *Monitoring, *Coastal zone management, *Adriatic Sea, *Data acquisition, Satellite technology, In situ tests, Pollutants, Fate of pollutants, Path of pollutants, Nutrients.

Since 1976 the Joint Research Center in Ispra, Italy, along with many national institutions, has been investigating the possibilities of monitoring marine ambience using satellite technology. The program includes remote sensing from space, in situ measurements, and modeling related to the main test site, the Northern Adriatic Sea. An overview is presented that covers the range of problems and future goals of the program: the use of space-borne sensors; in situ measurements that are conducted at least once a year over a one or two week sampling period; the use of airborne sensors to aid space sensors; and the Adriatic Sea model. This model is designed to predict short term pollutants; the propagation of nutrients and their secondary effects; and the long term propagation, transformation, and sedimentation of pollutants and nutrients and their possible resuspension. The initial conditions and limits of the model runs will be based as much as possible on remote sensing data from space, integrated with meteorological data, and in situ data. Further calibration will require extensive in situ measurements and the cooperative efforts of several institutions. (See also W89-08577) (White-Reimer-PTT)
W89-08585

HYDROLOGICAL COMPARISON OF LANDSAT TM, LANDSAT MSS AND BLACK & WHITE AERIAL PHOTOGRAPHY,
Aston Univ., Birmingham (England).
M. J. France, and P. D. Hedges.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management,

Enchede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 717-720, 5 tab, 4 fig, 7 ref.

Descriptors: *Remote sensing, *Satellite technology, *Hydrologic maps, Hydrologic data collections, Aerial photography, Landsat TM, Landsat MSS, North Wales, Mapping, Drainage patterns, Catchment areas, Lakes, Streams.

By enhancing four Landsat Multispectral scanner images and one Landsat Thematic Mapper quarter scene and examining black and white aerial photographs from the Dolgellau and Coed-y-Brenin area of North Wales, the techniques were quantitatively compared. The results indicated that the efficiency of Landsat TM imagery in defining drainage networks is significantly greater than that of Landsat MSS imagery. This results in more accurate delineation of catchment boundaries and catchment area estimation, particularly for small catchments. Within the catchment area, Landsat TM imagery provides useful information on geomorphological parameters, with the identification of lakes as small as 0.6 hectares, and small streams (3-5 meters wide) being fairly consistently recorded. Several different landcover types can be identified using Landsat TM imagery, and although there is more data to examine, the relative ease of interpretation compensates for this factor. For image enhancement of Landsat TM the most useful waveband combinations are 1,4,5,;2,4,5, and 3,4,5. Edge enhancement using a Laplacian filter, Sobel operator or directional filtering, with a 3x3 kernel further increases the drainage network detail. (See also W89-08577) (White-Reimer-PTT)
W89-08590

APPLICATION OF REMOTE SENSING IN HYDROMORPHOLOGY FOR THIRD WORLD DEVELOPMENT: A RESOURCE DEVELOPMENT STUDY IN PARTS OF HARYANA, INDIA,
Shivaji Univ., Kolhapur (India). Dept. of Geography.
A. S. Jadhav.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 721-724, 3 fig, 3 ref.

Descriptors: *Geomorphology, *Saline water, *Remote sensing, *Groundwater, Groundwater availability, Data acquisition, Groundwater potential, Groundwater pollution, Satellite technology, Aerial photography, Surveys, Mapping, Rajasthan, Uttarpradesh, Haryana, India, Potable water.

Conventional and satellite remote sensing techniques were used for obtaining information on the groundwater distribution, depth and quality for part of the Haryana, Rajasthan, and Uttarpradesh states of India. Special attention was given to delineate saline water and fresh water pockets in the semiarid regions of Haryana. The landscape method with an analysis of landforms for hydrological determinations was used for the three part study consisting of prefield interpretation, field work, and post field work. Using aerial photographs, imagery and toposheets it was determined that potable water pockets can be located with the help of remote sensing techniques, and the occurrence, distribution and degree of salinity of groundwater is closely associated with geomorphological processes and landforms in the region. The results showed that the area has good potential groundwater supplies, but faces acute groundwater quality problems. (See also W89-08577) (Author's abstract)
W89-08591

REMOTE SENSING AS A TOOL FOR ASSESSING ENVIRONMENTAL EFFECTS OF HYDROELECTRIC DEVELOPMENT IN A REMOTE RIVER BASIN,
Ontario Hydro, Toronto.
W. M. Paterson, and S. K. Sears.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 739-744, 3 fig, 16 ref.

Descriptors: *Remote sensing, *Environmental effects, *Surveys, *Mapping, Satellite technology, Landsat imagery, Hydroelectric power, Project planning, Baseline studies, Monitoring, Costs, Canada.

The feasibility of using remotely-sensed LANDSAT satellite data to assist in the development of new hydroelectric generation project studies in Ontario was assessed based on a pilot project carried out in a remote northern Ontario river basin. Thematic maps were produced for the Little Jackfish River at the Ontario Centre for Remote Sensing basin using digital analysis and visual interpretation of LANDSAT satellite data. Eleven hardcopy map sets were produced, and the entire drainage basin was mapped according to generalized land cover types using a geometrically corrected ground resolution. Based on a total study area of about 15,000 sq km, the approximate total cost to produce the maps was $40,000 or $2.67 per sq km which is less than the costs associated with conventional data collection methods (ground surveys and aerial photos). The results of the project indicate that the dynamic, generalized land cover mapping produced for the study are ideally suited to broad river system level planning exercises and conceptual assessments. Satellite data are also useful in scoping and conducting baseline inventories for detailed project assessments, particularly on large study areas where ground access is limited. In addition, prediction and monitoring of project-induced effects can be aided using remote sensing techniques. (See also W89-08577) (White-Reimer-PTT)
W89-08595

SATELLITE DATA IN AQUATIC AREA RESEARCH: SOME IDEAS FOR FUTURE STUDIES,
Jet Propulsion Lab., Pasadena, CA.
J. T. Raitala.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 755-758, 5 fig, 10 ref.

Descriptors: *Remote sensing, *Satellite technology, *Aquatic environment, Landsat images, Landsat MSS, Aquatic vegetation, Water depth, Environmental effects, Data processing, Surveys, Mapping, Finland.

Computer-aided digital remote sensing techniques were used to evaluate the usefulness of Landsat Multispectial Scanner data in aquatic studies. Some of the potential uses of the Landsat data indicated by these investigation include: (1) In addition to depth information the MSS data may also include useful information about Secchi disc values, humus content in water and productivity; (2) Aquatic vegetation classification where vegetation units are big enough in respect to the 0.5 hectares ground resolution (different life-forms such as helophytes, nympheids, elodeids, bryophytes, can be mapped quite easily, but when using the supervised classification procedure even some minor nuances can be traced); and (3) Using multitemporal satellite imagery to evaluate alterations within the littoral areas of some Finnish water reservoirs between successive periods of high water and also along the shallow coastal sea of the Gulf of Bothnia. However, due to the limitations of MSS data in exact small-scale interpretations, the importance of relevant water chemical and field data must not be underestimated. The more advanced TM and SPOT data will be useful in situations where MSS data has poor ground resolution and too broad and too few spectral channels, but the MSS data will continue to be important for determining environmental changes. (See also W89-08577) (Author's abstract)
W89-08597

STUDY WITH NOAA-7 AVHRR-IMAGERY IN MONITORING EPHEMERAL STREAMS IN THE LOWER CATCHMENT AREA OF THE TANA RIVER, KENYA,
DHV Consulting Engineers, Amersfoort (Netherlands).
J. W. van den Brink.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 783-785, 1 tab, 1 fig, 11 ref.

Descriptors: *Remote sensing, *Monitoring, *Streamflow, Satellite imagery, Kenya, Vegetation, NOAA-7 AVHRR system, AVHRR system, Tana River, Ephemeral streams, Data acquisition.

A case study to evaluate the NOAA-7 Advanced High-Resolution Radiometer system for obtaining hydrological information by monitoring the vegetation growth in the lower catchment area of the Tana River was conducted. Emphasis was on the assessment of the hydrologic influence of the ephemeral streams in the lower catchment area. The digital image processing routines that were used consisted merely of image enhancements in order to obtain an optimal visual representation. In addition, the normalized difference images: (c2-c1)/(c2+c1) of the near-infrared and red channel respectively channel 2 and 1, were calculated for both days. This 'biomass index' was considered a successful variable which correlates well with the green leaf biomass of vegetation. Due to the presence of severe cloud cover over the area, no imagery was obtained by the NOAA-7 AVHRR system of sufficient quality to derive the desired information over a period of five months and an almost daily coverage of the satellite system. However, the AVHRR images would be useful for investigating and monitoring the vegetation growth in smaller regions. The radiometry and spatial resolution are sufficient to allow for this type of application. (See also W89-08577) (White-Reimer-PTT)
W89-08603

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
Proceedings of the Seventh International Symposium on Remote Sensing for Resources Development and Environmental Management, ISPRS Commission VII, Enschede, 25-29 August 1986. Volume Three. A.A. Balkema, Boston. 1986. 118p. Edited by M.C.J. Damen, G. Sicco Smit and H.Th. Verstappen.

Descriptors: *Remote sensing, *Monitoring, *Mapping, *Planning, Satellite technology, Data acquisition, Data processing, Aerial photography, Assessment and Information Services Center, National Environmental Satellite, Data, and Information Service, National Oceanic and Atmospheric Administration, Regional planning, Project planning.

A collection of papers introducing a symposium on remote sensing for resources development and environmental management presented. The uses of remote sensing for monitoring and mapping in order to determine future planning strategies is discussed as well as the latest technologies and data processing techniques. The role of agencies such as the Assessment and Information Services Center (AISC), the National Environmental Satellite, Data, and Information Service (NESDIS), and National Oceanic and Atmospheric Administration (NOAA) in collecting and processing remote sensing data and the need to coordinate conventional methodologies with satellite programs are examined. (See W89-08610 thru W89-08611, W89-08572, W89-08577) (White-Reimer-PTT)
W89-08609

MONITORING ENVIRONMENTAL RESOURCES THROUGH NOAA'S POLAR ORBITING SATELLITES,
National Oceanic and Atmospheric Administration, Washington, DC. Assessment and Information Services Center.
For primary bibliographic entry see Field 7B.
W89-08611

GROUND-WATER QUALITY AND GEOCHEMISTRY OF LAS VEGAS VALLEY, CLARK

COUNTY, NEVADA, 1981-83: IMPLEMENTATION OF A MONITORING NETWORK,
Geological Survey, Carson City, NV. Water Resources Div.
M. D. Dettinger.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water Resources Investigation Report 87-4007, 1987. 69p, 15 fig, 5 tab, 39 ref.

Descriptors: *Network design, *Water quality, *Urbanization, *Hydrologic data, *Groundwater quality, *Geochemistry, *Monitoring, *Nevada, Las Vegas, Groundwater pollution, Wastewater disposal, Irrigation, Data acquisition, Monitoring wells, Dissolved solids, Calcium, Magnesium, Bicarbonates, Sulfates, Salinity.

As a result of rapid urban growth in Las Vegas Valley, rates of water use and wastewater disposal have grown rapidly during the last 25 years. Concern has developed over the potential water quality effects of this growth. The deep percolation of wastewater and irrigation return flow (much of which originates as imported water from Lake Mead), along with severe overdraft conditions in the principal aquifers of the valley, could combine to pose a long-term threat to groundwater quality. The quantitative investigations of groundwater quality and geochemical conditions in the valley necessary to address these concerns would include the establishment of data collection networks on a valley-wide scale that differ substantially from existing networks. The valley-wide networks would have a uniform areal distribution of sampling sites, would sample from all major depth zones, and would entail repeated sampling from each site. With these criteria in mind, 40 wells were chosen for inclusion in a demonstration monitoring network. Groundwater in the northern half of the valley generally contains 200 to 400 mg/L of dissolved solids, and is dominated by calcium, magnesium, and bicarbonate ions, reflecting a chemical equilibrium between the groundwater and the dominantly carbonate rocks in the aquifers of this area. The intermediate to deep groundwater in the southern half of the valley is of poorer quality (containing 700 to 1,500 mg/L of dissolved solids) and is dominated by calcium, magnesium, sulfate, and bicarbonate ions, reflecting the occurrence of other rock types including evaporite minerals among the still-dominant carbonate rocks in the aquifers of this part of the valley. The poorest quality groundwater in the valley is generally in the lowland parts of the valley in the first few feet beneath the water table, where dissolved solids concentrations range from 2,000 to > 7,000 mg/L, and probably reflects the effects of evaporite dissolution, secondary recharge, and evapotranspiration. The most common water quality constraint on potential groundwater use is the high salinity. No evidence of large-scale contamination of deep groundwater was found in this study. (Author's abstract)
W89-08632

IDENTIFICATION AND DESCRIPTION OF POTENTIAL GROUND-WATER QUALITY MONITORING WELLS IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. R. Seaber, and M. E. Thagard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4130, 1986. 124p, 12 fig, 8 tab, 63 ref.

Descriptors: *Monitoring wells, *Groundwater quality, *Florida, *Hydrologic data collections, *Network design, Aquifers, Computers, Data acquisition, Monitoring, Data collections.

The results of a survey of existing wells in Florida that meet the following criteria are presented: (1) well location is known, (2) principal aquifer is known, (3) depth of well is known, (4) well casing depth is known, (5) well water had been analyzed between 1970 and 1982, and (6) well data are stored in the U.S. Geological Survey's (USGS) computer files. Information for more than 20,000 wells in Florida were stored in the USGS Master Water Data Index of the National Water Data Exchange and in the National Water Data Storage and Retrieval System's Groundwater Site Inventory computerized files in 1982. Wells in these computer files that had been sampled for groundwater quality before November 1982 in Florida number 13,739; 1,846 of these wells met the above criteria and are the potential (or candidate) groundwater quality monitoring wells included in this report. The distribution by principal aquifer of the 1,846 wells identified as potential groundwater quality monitoring wells is as follows: 1,022 tap the Floridan aquifer system, 114 tap the intermediate aquifers, 232 tap the surficial aquifers, 246 tap the Biscayne aquifer, and 232 tap the sand-and-gravel aquifer. These wells are located in 59 of Florida's 67 counties. This report presents the station descriptions, which include location, site characteristics, period of record, and the type and frequency of chemical water quality data collected for each well. The 1,846 well locations are plotted on 14 USGS 1:250,000 scale, 1 degree by 2 degree, quadrangle maps. This relatively large number of potential (or candidate) monitoring wells, geographically and geohydrologically dispersed, provides a basis for a future groundwater quality monitoring network and computerized data base for Florida. There is a large variety of water quality determinations available from these wells, both areally and temporally. Future sampling of these wells would permit analyses of time and areal trends for selected water quality characteristics throughout the State. The identification and description of the potential monitoring wells and the listing of the type and frequency of the groundwater quality data forms a foundation for both the network and the data base. (Author's abstract)
W89-08722

WATER-QUALITY APPRAISAL OF NASQAN STATIONS BELOW IMPOUNDMENTS, EASTERN TENNESSEE,
Geological Survey, Knoxville, TN. Water Resources Div.
R. D. Evaldi, and J. G. Lewis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4171, 1986. 50p, 11 fig, 20 tab, 16 ref.

Descriptors: *Networks, *Dam effects, *Streamflow, *Network design, *Monitoring, *Water quality, *National Stream Quality Accounting Network, *Ecological effects, *Reservoirs, *Tennessee, Water resources development, Data acquisition, Clinch River, Tennessee River.

The National Stream Quality Accounting Network (NASQAN) is a network of stations at which systematic and continuing water quality data are collected. Major objectives of this U.S. Geological Survey program are: (1) to depict areal variability of streamflow and water quality conditions nationwide on a year-by-year basis and (2) to detect long-term changes in streamflow and stream quality. Several NASQAN stations in East Tennessee are downstream from impoundments which have a significant effect on water quality. NASQAN data obtained from the Tennessee River below Watts Bar Dam and the Clinch River below Melton Hill Dam were compared to water quality data from the basins upstream. The comparison indicates that NASQAN data obtained below impoundments may not be adequate to describe a composite picture of water quality in the accounting unit. Detention time of storage in the impoundments is believed to moderate the range of constituent values observed at the NASQAN stations. Data obtained upstream and downstream from Watts Bar Dam indicate that the water sampled at the NASQAN station comes from stratified layers of the impoundment and is not representative of an integrated sample of water from the impoundment. Values of total recoverable iron suggest that, because of adsorption onto sediments in impoundments, some constituents are not accurately described by sampling below impoundments. Relations between water quality constituents and flow at stations on the Clinch River and Tennessee River are not well defined due to regulation. Direct load computations for many constituents were therefore not possible, which diminished the utility of data from these NASQAN stations to account for quantity versus quality of the water. Load computations were only possible for ionic constituents through use of a continuous specific conductance record as an intermediary. Rivers might reflect the decreasing trend in discharge during the 1972-82 water years. Thus the stations below Watts Bar Dam and below Melton Hill Dam do not adequately meet the NASQAN objective to detect and assess long-term changes in stream quality. (Lantz-PTT)
W89-08750

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08760

COST-EFFECTIVENESS OF THE FEDERAL STREAM-GAGING PROGRAM IN VIRGINIA,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08761

DESIGN OF A SEDIMENT DATA-COLLECTION PROGRAM IN KANSAS AS AFFECTED BY TIME TRENDS,
Geological Survey, Lawrence, KS. Water Resources Div.
P. R. Jordan.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4204, 1985. 114p, 5 fig, 5 tab, 53 ref.

Descriptors: *Data acquisition, *Sediment concentration, *Sedimentation, *Project planning, *Network design, *Kansas, Streamflow, Temporal distribution.

Data collection programs need to be re-examined periodically in order to insure their usefulness, efficiency, and applicability. The possibility of time trends in sediment concentration, in particular, makes the examination with new statistical techniques desirable. After adjusting sediment concentrations for their relation to streamflow rates and by using a seasonal adaptation of Kendall's nonparametric statistical test, time trends of flow-adjusted concentrations were detected for 11 of the 38 sediment records tested that were not affected by large reservoirs. Ten of the 11 trends were toward smaller concentrations; only 1 was toward larger concentrations. Of the apparent trends that were not statistically significant (0.05 level) using data available, nearly all were toward smaller concentrations. Because the reason for the lack of statistical significance of an apparent trend may be inadequacy of data rather than absence of trend and because of the prevalence of apparent trends in one direction, the assumption was made that a time trend may be present at any station. This assumption can significantly affect the design of a sediment data collection program. Sudden decreases (step trends) in flow-adjusted sediment concentrations were found at all stations that were short distances downstream from large reservoirs and that had adequate data for a seasonal adaptation of Wilcoxon's nonparametric statistical test. Examination of sediment records in the 1984 data collection program of the Kansas Water Office indicated 13 stations that can be discontinued temporarily because data are now adequate. Data collection could be resumed in 1992 when new data may be needed because of possible time trends. New data are needed at eight previously operated stations where existing data may be inadequate or misleading because of time trends. Operational changes may be needed at some stations, such as hiring contract observers or installing automatic pumping samplers. Implementing the changes in the program can provide a substantial increase in the quantity of useful information on stream sediment for the same funding as the 1984 level. (Author's abstract)
W89-08824

Group 7A—Network Design

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott, W. B. Gannon, and W. H. Johnston.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4328, 1986. 86p, 9 fig, 8 tab, 21 ref.

Descriptors: *Network design, *Cost analysis, *Project planning, *Data acquisition, *Stream gages, New York, Economic aspects, Streamflow, Statistical analysis, Mathematical studies.

The U.S. Geological Survey conducted a 5-year nationwide analysis to define and document the most cost effective means of obtaining streamflow data. This report describes the stream gaging network in New York and documents the cost effectiveness of its operation; it also identifies data uses and funding sources for the 174 continuous-record stream gages currently operated (1983). Those gages as well as 189 crest-stage, stage-only, and groundwater gages are operated with a budget of $1.068 million. One gaging station was identified as having insufficient reason for continuous operation and was converted to a crest-stage gage. Current operation of the 363-station program requires a budget of $1.068 million/yr. The average standard error of estimation of continuous streamflow data is 13.4%. Results indicate that this degree of accuracy could be maintained with a budget of approximately $1.006 million if the gaging resources were redistributed among the gages. The average standard error for 174 stations was calculated for five hypothetical budgets. A minimum budget of $970,000 would be needed to operated the 363-gage program; a budget less than this does not permit proper servicing and maintenance of the gages and recorders. Under the restrictions of a minimum budget, the average standard error would be 16.0%. The maximum budget analyzed was $1.2 million, which would decrease the average standard error to 9.4%. (Author's abstract)
W89-09031

PROCEDURAL GUIDE FOR INTERNATIONAL GAUGING STATIONS ON BOUNDARY WATERS BETWEEN CANADA AND THE UNITED STATES OF AMERICA,
Geological Survey, Reston, VA. Water Resources Div.
S. Huberman, J. E. Slater, and A. Condes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-329, 1985. WRB Report 1 WD-HQ-WRB-PG-85-1. 105p, 1 plate, 11 append.

Descriptors: *Data acquisition, *Stream gages, *Treaties, *Gaging stations, *Standards, *International agreements, *Canada, Monitoring, Streamflow measurement, Water level, Great Lakes, St. Lawrence River.

Since 1909, the United States of America and Canada have employed a system of monitoring streamflow and water levels for shared waters based upon professionalism, trust and goodwill. This document has been prepared in considerable detail for use by managers and field officers at all levels of government in Canada and the United States. Its purpose is to serve as a guide in attaining uniform procedures in the designation and operation of International Gaging Stations. For special situations where these procedures do not apply, specific mention is made in appropriate sections of the guide. (Lantz-PTT)
W89-09089

OPERATION OF HYDROLOGIC DATA COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1985,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09103

ANALYSIS OF SURFACE-WATER DATA NETWORK IN KANSAS FOR EFFECTIVENESS IN PROVIDING REGIONAL STREAMFLOW INFORMATION--WITH A SECTION ON THEORY AND APPLICATION OF GENERALIZED LEAST SQUARES,
Geological Survey, Lawrence, KS. Water Resources Div.
K. D. Medina, and G. D. Tasker.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-680, 1985. 39p, 11 fig, 5 tab, 8 ref.

Descriptors: *Data interpretation, *Streamflow, *Surface water, *Kansas, *Network design, Flow profiles, Least squares method, Stream gages, Performance evaluation, Low flow, High flow, Statistical analysis, Mathematical studies.

The surface water data network in Kansas was analyzed using generalized least squares regression for its effectiveness in providing regional streamflow information. The correlation and time-sampling error of the streamflow characteristic are considered in the generalized least squares method. Unregulated medium-flow, low-flow and high-flow characteristics were selected to be representative of the regional information that can be obtained from streamflow gaging station records for use in evaluating the effectiveness of continuing the present network stations, discontinuing some stations; and/or adding new stations. The analysis used streamflow records for all currently operated stations that were not affected by regulation and discontinued stations for which unregulated flow characteristics, as well as physical and climatic characteristics, were available. The state was divided into three network areas, western, northeastern, and southeastern Kansas, and analysis was made for three streamflow characteristics in each area, using three planning horizons. The analysis showed that the maximum reduction of sampling mean square error for each cost level could be obtained by adding new stations and discontinuing some of the present network stations. Large reductions in sampling mean square error for low-flow information could be accomplished in all three network areas, with western Kansas having the most dramatic reduction. The addition of new stations would be most beneficial for man- flow information in western Kansas, and to lesser degrees in the other two areas. The reduction of sampling mean square error for high-flow information would benefit most from the addition of new stations in western Kansas, and the effect diminishes to lesser degrees in the other two areas. Southeastern Kansas showed the smallest error reduction in high-flow information. A comparison among all three network areas indicated that funding resources could be most effectively used by discontinuing more stations in northeastern and southeastern Kansas and establishing more new stations in western Kansas. (Author's abstract)
W89-09105

SURFACE WATER-QUALITY ASSESSMENT OF THE LOWER KANSAS RIVER BASIN, KANSAS AND NEBRASKA: PROJECT DESCRIPTION,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09235

7B. Data Acquisition

NUMERICAL MODELING OF TIDE AND CIRCULATION IN CENTRAL PUGET SOUND: COMPARISON OF A THREE-DIMENSIONAL AND A DEPTH-AVERAGED MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W89-08352

STREAMFLOWS IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08353

GEOSTATISTICAL INTERPOLATION OF HYDROSTRATIGRAPHY AT GROUNDWATER CONTAMINATION SITES,
California Univ., Santa Cruz. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W89-08370

WATER QUALITY DATA FOR THE BOISE RIVER, BOISE TO STAR, IDAHO, JANUARY TO MARCH 1988,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-08382

WATER QUALITY ASSESSMENT OF ARVADA RESERVOIR, DENVER METROPOLITAN AREA, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-08411

SOIL-WATER HYDROLOGY AND GEOCHEMISTRY OF A COAL SPOIL AT A RECLAIMED SURFACE MINE IN ROUTT COUNTY, COLORADO,
For primary bibliographic entry see Field 5B.
W89-08413

CONSTRUCTION, GEOLOGIC, AND WATER LEVEL DATA FOR OBSERVATION WELLS NEAR BRENTWOOD, WILLIAMSON COUNTY, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08414

DIRECT-CURRENT RESISTIVITY DATA FROM 94 SITES IN NORTHEASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Stuart, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08415

HISTORY OF SUSPENDED SEDIMENT DATA COLLECTION AND INVENTORY OF AVAILABLE DATA FOR THE TENNESSEE AND CUMBERLAND RIVER BASINS,
Geological Survey, Nashville, TN. Water Resources Div.
W. P. Carey, R. T. Brown, and C. G. Chatham.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-497, 1988. 101p, 5 fig, 3 tab, 29 ref.

Descriptors: *Sampling, *Data collections, *Suspended sediments, *Sediment discharge, *Tennessee River Basin, Cumberland River Basin, Suspended load, Sediment transport, Sediment concentration, Data storage and retrieval.

In 1934 and 1935, the Tennessee Valley Authority established 51 daily record suspended-sediment stations on the Tennessee River and its major tributaries. Most of these stations were operated for 8 years. From 1962 to 1965, the Tennessee Valley Authority again collected daily sediment record at 10 of the original 49 stations. In addition to the data sets collected on the major rivers, the Tennessee Valley Authority has conducted several intensive studies of small watersheds throughout the Tennessee River basin. In the Cumberland River basin, daily sediment records have been collected primarily by the Survey. Daily stations have been operated for various periods on 17 basins ranging in size from 0.67 to 1,977 sq mi, with the earliest data of daily record being October 1953. All of

these daily stations are located in the upper Cumberland River basin upstream of any major impoundments. Periodic sediment data have been collected by the Survey at 194 stations in the Tennessee River basin and at 106 stations in the Cumberland River basin, however; the number of samples/station is quite low. 86% of the periodic stations in the Tennessee River basin and 91% of the periodic stations in the Cumberland River basin have 30 samples or less. (USGS)
W89-08416

FIELD CONDITIONS AT THE MARICOPA AGRICULTURAL CENTER, MARICOPA AGRICULTURAL CENTER, MARICOPA COUNTY, ARIZONA, JUNE 13, 1988,
Geological Survey, Tucson, AZ. Water Resources Div.
S. J. Own-Joyce.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-708, 1988. 5p, 2 tab.

Descriptors: *Agriculture, *Photography, *Remote sensing, *Data collections, *Crop data, *Arizona.

Field conditions were documented during the Landsat satellite overpass of the Maricopa Agricultural Center, Maricopa County, Arizona, on June 13, 1988. Crop types were mapped and photographed for each demonstration farm field. Field conditions described include irrigation, cultivation, and orientation of rows. Field and photographic descriptions are presented in tabular form. (USGS)
W89-08423

FLOODFLOW CHARACTERISTICS OF WYOMING STREAMS-A COMPILATION OF PREVIOUS INVESTIGATIONS,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08450

OPERATING MANUAL FOR THE R200 DOWNHOLE RECORDER WITH HUSKY HUNTER RETRIEVER,
Geological Survey, NSTL Station, MS. Hydrologic Instrumentation Facility.
R. A. Johnson, and J. I. Rorabaugh.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $17.75, microfiche $4.50. USGS Open-File Report 88-455, Nov. 1988. 111p, 10 fig. USGS project WD141.

Descriptors: *Instrumentation, *Groundwater, *Electronic recorders, *Water level recorders, Pressure transducers.

The R200 Downhole Recorder is a battery-powered device that, when placed in a well casing, monitors water levels for a period of up to 1 year. This instrument measures a 1- to 70-foot range of water levels. These water-level data can be retrieved through use of a commercially available portable microcomputer. The R200 Downhole Recorder was developed at the U.S. Geological Survey's Hydrologic Instrumentation Facility, Stennis Space Center, Mississippi. This operating manual describes the R200 Downhole Recorder, provides initial set-up instructions, and gives directions for on-site operation. Design specifications and routine maintenance steps are included. The R200 data-retriever program is a user-friendly, menu-driven program. The manual guides the user through the procedures required to perform specific operations. Numerous screens are reproduced in the text with a discussion of user input for desired responses. Help is provided for specific problems. (USGS)
W89-08454

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 10: AN ANALYSIS OF NUMERICAL MODELS OF AIR POLLUTANT EXPOSURE AND VEGETATION RESPONSE,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W89-08492

FISH ACUTE TOXICITY SYNDROMES: APPLICATION TO THE DEVELOPMENT OF MECHANISM-SPECIFIC QSARS (QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIPS),
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W89-08520

IMPROVED PARAMETERIZATIONS FOR SURFACE RESISTANCE TO GASEOUS DRY DEPOSITION IN REGIONAL-SCALE, NUMERICAL MODELS,
Argonne National Lab., IL. Biological and Medical Research Div.
For primary bibliographic entry see Field 5B.
W89-08536

ENDOW: AN APPLICATION OF AN EXPERT SYSTEM IN TECHNOLOGY TRANSFER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6A.
W89-08542

FLEXIBLE REGIONAL EMISSIONS DATA SYSTEM (FREDS) DOCUMENTATION FOR THE 1980 NAPAP EMISSIONS INVENTORY,
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W89-08545

EFFECT OF CORRELATED INPUTS ON DO UNCERTAINTY,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08549

INTERIM PROTOCOL FOR MEASURING HYDROLYSIS RATE CONSTANTS IN AQUEOUS SOLUTIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5G.
W89-08550

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08572

PRELIMINARY ASSESSMENT OF AN AIRBORNE THERMAL VIDEO FRAME SCANNING SYSTEM FOR ENVIRONMENTAL ENGINEERING SURVEYS,
Surrey Univ., Guildford (England).
T. J. M. Kennie, C. D. Dale, and G. C. Stove.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume One. A.A. Balkema, Boston. 1986. p 285-290, 4 tab, 5 fig, 22 ref.

Descriptors: *Remote sensing, *Infrared imagery, *Aerial photography, *Data acquisition, *Thermal properties, Drainage patterns, Thermal video frame scanners, Thermal imagery, Mapping, Surveys, Environmental engineering, Environmental effects, Monitoring.

The advantages of video based cameras for remote sensing include ease of use, speed of operation, portability and cost. The thermal video frame scanning (TVFS) systems, unlike thermal IR linescanning systems which are designed specifically for airborne use, are designed for both ground and airborne operation. Consequently, the optical configuration, scanning mechanism and detector arrays differ from those used for thermal linescanning and this leads to significantly different imaging systems being employed. The processing of video based thermal data consists of conversion of the analogue video recording to a digital format, preprocessing of the digital data to remove image inconsistencies, and/or to rectify and geometrically correct the image, and processing and analysis of the data using conventional image processing techniques. The Barr and Stroud IR18 Mk II scanner described was used successfully for aerial scanning tests for monitoring heat loss from industrial and residential buildings, thermal mapping of roads, geotechnical site investigation, and drainage, sewer collapse and utilities surveys. (See also W89-08572) (White-Reimer-PTT)
W89-08573

LAND USE ALONG THE TANA RIVER, KENYA--A STUDY WITH SMALL FORMAT AERIAL PHOTOGRAPHY AND MICROLIGHT AIRCRAFT,
DHV Consulting Engineers, Amersfoort (Netherlands).
R. Beck, S. W. Taiti, and D. C. P. Thalen.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume One. A.A. Balkema, Boston. 1986. p 375-380, 1 tab, 7 fig.

Descriptors: *River systems, *Land use, *Aerial photography, *Riparian land, *Flood plains, Flood plain management, Data acquisition, Indirect flood measurement, Vertical photography, Stereoscopic analysis, Photoblocks, Inventories, Tana River, Kenya.

Monitoring of land use on the riverine lands along the Lower Tana River in Kenya was conducted using a microlight aircraft equipped with small format cameras. The land utilization types identified were based on the association of land use practices, ethnic identities, ecological entities, etc. which coincide with certain environmental conditions that are affected by the flooding regime. The use of the microlight aircraft enabled inaccessible areas to be surveyed. The vertical photography was produced with overlap for stereoscopic analysis of preselected areas, or strips which were selected during the flight. In addition, photoblocks were photographed of areas to 300ha with reasonable sidelap and overlap. The results of the inventory of land utilization types was combined with the results of model calculations on the future river morphology enabling impacts on land uses and remedial measures to be assessed. (See also W89-08572) (White-Reimer-PTT)
W89-08574

APPLICATION OF MULTISPECTRAL SCANNING REMOTE SENSING IN AGRICULTURAL WATER MANAGEMENT PROBLEMS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
G. J. A. Nieuwenhuis, and J. M. M. Bouwmans.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume One. A.A. Balkema, Boston. 1986. p 489-494, 1 tab, 9 fig, 16 ref.

Descriptors: *Remote sensing, *Water management, *Evapotranspiration, *Agricultural hydrology, Drought, Aerial photography, Thermal imaging, Reflection imaging, Mapping, Data acquisition, Model studies, Cropland, The Netherlands.

A method for automatically mapping the evapotranspiration from digitally taken reflection and thermal images has been developed. The accuracy of the map obtained with this remote sensing method is dependent on the availability of an accurate crop map, and the ability to distinguish different crops is dependent on the growth stage. The examples presented demonstrate the applicability of the technique for determining effects of certain water management measures, variations in the physical characteristics of soil, and drought damage. Important improvements in the hydrological description of an area can be achieved by combining the remote sensing approach with conventional methods. The main advantage of remote sensing is the actual crop water supply can be

determined for large areas. By using models, crop water supply can be simulated for certain locations during the entire growing season and the obtained results verified using remote sensing. This verification would be impossible using conventional techniques. In humid areas like the Netherlands with rapidly changing weather conditions, remote sensing in water management must rely mainly on airplane scanning techniques. (See also 89-08572) (White-Reimer-PTT)
W89-08575

PHOTO-INTERPRETATION OF WETLAND VEGETATION IN THE LESSER ANTILLES,
Office National des Forets, Basse-Terre (Guadeloupe).
B. Rollet.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enchede, August 1986. Volume One. A.A. Balkema, Boston. 1986. p 499-504, 8 fig, 16 ref.

Descriptors: *Wetlands, *Aerial photography, *Lesser Antilles, *Mapping, *Mangrove swamps, Data acquisition, Data processing, Vegetation, Mud flats, Swamps, Pterocarpus, Chrysobalanus, Sedge, Fern, Saltflats, Urbanization, Agriculture, Guadeloupe, Martinique.

It is possible to distinguish the following major wetland vegetation types on 1:20000 panchromatic aerial photos: mangrove as a whole and its subtypes; Pterocarpus swamp forest; dry deciduous or semi evergreen forest on karst; Chrysobalanus thicket, sedge and fern swamps; and mudflat with algal cover, saltflats. This information provides a framework that is augmented by field checks that correct the interpretation and facilitate the extrapolation for mapping. Further ecological observations will provide explanations for the present spatial distribution of vegetation and its evolution in time. In this study air-photos over the last 20 to 35 years have been compared to determine the effects on wetlands vegetation of recent modifications. Although no drastic changes have occurred, there is a slow insidious regression of forested areas. The most important factor is urbanization and road construction with agriculture the second most important factor. At this time the largest wetlands in the Lesser Antilles occur in Guadeloupe, followed by Martinique. It is recommended that soil studies in wetlands be developed in conjunction with the vegetation studies. (See also W89-08572) (White-Reimer-PTT)
W89-08576

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08577

SPRING MOUND AND AIOUN MAPPING FROM LANDSAT TM IMAGERY IN SOUTH-CENTRAL TUNISIA,
Reading Univ. (England).
A. R. Jones, and A. Millington.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 607-613, 3 tab, 7 fig, 16 ref. NERC Studentship GT4/83/GS/87.

Descriptors: *Remote sensing, *Springs, *Tunisia, *Satellite technology, *Aquifers, Data acquisition, Groundwater, Upwellings, Aioun, Playas, Mapping, Geologic fractures, Hydrogeology.

The advantages of remotely sensed imagery over conventional ground survey for the detection of spring mounds and aioun on playas in terms of overcoming logistical and geomorphological aspects and in enabling advantage to be taken of the shape and spectral characteristics of these features is discussed. Another advantage of mapping the distribution of these features from satellite imagery is that directional trends can readily be identified and summarized. The results of this analysis indicates that on the Chott el Fedjadj spring mound lineaments occurred in one main direction, E-W to SE-NW, associated with rock subcrops and faulting parallel to the fold axes of the Chott el Fedjadj anticline. A secondary direction, NNE-SSW, was identified which is related to faulting and jointing perpendicular to the main fold axis. Wind gaps along the Djebel Tebaga are probably associated with this faulting and jointing. The aioun field in the Chott el Djerid is orientated in a NNE-SSW direction and appears to be related to the undercrop of aquifers or large scale faulting at the buried nose of the Chott el Fedjadj anticline. (See also W89-08577) (White-Reimer-PTT)
W89-08579

MONITORING GEOMORPHOLOGICAL PROCESSES IN DESERT MARGINAL ENVIRONMENTS USING MULTITEMPORAL SATELLITE IMAGERY,
Reading Univ. (England).
A. C. Millington, A. R. Jones, N. Quarmby, and J. R. G. Townshend.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enchede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 631-637, 1 tab, 6 fig, 31 ref. NERC Studentship GT4/83/GS/87.

Descriptors: *Remote sensing, *Satellite technology, *Geomorphology, *Tunisia, Data interpretation, Multitemporal satellite imagery, Monitoring, Landsat imagery, SPOT imagery, Mapping, Playas, Aeolian deposits, Sediment distribution, Surface water, Groundwater.

Evidence from southern Tunisia has shown that seasonal and long-term changes in playa geomorphological phenomena can be detected using digitally processed Landsat and SPOT imagery. However, when examining such changes it is important to establish a framework of the temporal and spatial dimensions of change for comparison with changes detected on different types of imagery. Three classes of geomorphological changes were identified with reference to satellite data: sub-sampling unit changes; seasonal changes; and long-term changes. The latter two types of changes can be seen on both MSS and TM imagery. This finding suggests that the changes are large enough to be detected even with coarser spatial resolution MSS imagery. However, the spectral resolving power provided by TM imagery does enable changes in salt and sediment patterns and moisture levels to be more readily recognized. In contrast, on MSS imagery many of the changes that can be seen are related to large variations in overall reflectance and vegetation. The results of this study showed the important role of surface water in redistributing sediment and salts on Tunisian playas. In many facies it appears to be equally, if not more, important than groundwater. Furthermore, interactions with adjacent landforms and the role of aeolian activity are also locally important. (See also W89-08577) (White-Reimer-PTT)
W89-08581

REMOTE SENSING ASSESSMENT OF ENVIRONMENTAL IMPACTS CAUSED BY PHOSPHAT INDUSTRY DESTRUCTIVE INFLUENCE,
Academy of Mining and Metallurgy, Krakow (Poland).
S. C. Mularz.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 639-644, 1 tab, 7 fig, 5 ref.

Descriptors: *Water pollution sources, *Remote sensing, *Monitoring, *Aerial photography, *Thermal imaging, *Waste dumps, *Data acquisition, Data processing, Data interpretation, Industrial wastes, Mapping, Environmental effects, Pollutants, Phosphates, Pollutant identification, Poland.

A number of remote sensing techniques including color aerial photography, black and white aerial photography, and thermal imaging have been used to detect adverse environmental impacts associated with the location of a phosphogypsum dump area. Based on the analog and digital data processing of the aerial photographs, it was demonstrated that the shifting nature of the dump causes technological problems, contributes to the cyclical nature of the toe-failure process, and has an adverse effect on the natural environment. Photointerpretation distinguished two stages in the mass movement; a preliminary stage, and a stage of intensive movement that are correlated with the dumping pattern. It was determined that the surface water, groundwater, and vegetation are being damaged by the phosphogypsum dump due to contaminated water flowing from the dump to the surface water. During both flooding and draining the water runoff is accelerated by the existence of the dump and results in new drainage patterns and morphological elevations. (See also W89-08577) (White-Reimer-PTT)
W89-08582

SMALL SCALE EROSION HAZARD MAPPING USING LANDSAT INFORMATION IN THE NORTHWEST OF ARGENTINA,
For primary bibliographic entry see Field 7C.
W89-08583

METHODOLOGY FOR INTEGRATING SATELLITE IMAGERY AND FIELD OBSERVATIONS FOR HYDROLOGICAL REGIONALISATION IN ALPINE CATCHMENTS,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 7C.
W89-08584

SHAPE AND VARIABILITY OF THE ABSORPTION SPECTRUM OF AQUATIC HUMUS,
Technische Hogeschool Delft (Netherlands).
H. Buiteveld, F. de Jong, R. Spanhoff, and M. Donze.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 703-705, 1 tab, 2 fig, 5 ref.

Descriptors: *Decomposing organic matter, *Atomic absorption spectrophotometry, *Spectral analysis, *Chemical analysis, The Netherlands, Model studies, Data processing, Mathematical models, Correlation analysis.

The absorption spectra of humus from surface water samples collected in The Netherlands were measured with a double beam spectrophotometer, and the reflection spectra were measured with a multispectral scanner. The results demonstrate that the shape of the humus absorption spectrum cannot be described by an exponential function. It also appears that there is considerable variability in the humus absorption spectrum. If actual aquatic humus absorption spectra measurements are used for the deconvolution algorithm, improvement in the accuracy of the interpretation of airborne reflection measurements may be expected. Further progress in the mathematical description of the absorption spectrum of humus will require models more complicated than an exponential curve. The preliminary results obtained by applying conventional factor analysis to the data-set indicate that four components are sufficient to cover the observed variability of shape. More accurate correlations between optical and chemical humus data may be possible with this system than with the exponential model. (See also W89-08577) (White-Reimer-PTT)
W89-08586

RAINLOG AND PRESLOG: NOVEL TOOLS FOR IN-SITU MEASUREMENTS,
International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).
D. de Hoop.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 707.

Descriptors: *Rain gages, *Logging (Recording), *Measuring instruments, *In situ tests, *Monitor-

ing, Rainlog, Preslog, Flow measurement, Flowmeters, Stream gages, Groundwater level, Rain gages, Automation, Computers.

The rainlog and preslog electronic water level loggers measure and record water pressure over long periods without requiring maintenance or battery changes. The pressure recordings are controlled by a microprocessor and are stored in a removable internal memory block that can be read by a personal computer with an 'Eprom reader'. Two types of sensors are available, the rainlog with a relative pressure sensor and a range of 2 meters, and the preslog with an absolute pressure sensor and a range of 0 to 2 bar (at sea level a range of 30 meters). The loggers are designed for both accuracy and durability. All parts except the removable memory block must be permanently attached to the internal panel and the panel firmly placed in the steel cylinder. To record river levels a logger is anchored in the river bed and left for a maximum of 12 months. It is then retrieved and opened and the memory block removed and read. Preslog can be placed in waterpipes and used as a groundwater level logger. Rainfall data can be collected by recording pressure changes in a rain collection container. (See also W89-08577) (White-Reimer-PTT)
W89-08587

DELINEATION AND CLASSIFICATION OF INLAND WETLANDS UTILIZING FCIR STEREO IMAGERY,
S. A. Estrin.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 713-716, 13 ref.

Descriptors: *Infrared imagery, *Remote sensing, *Wetlands, Vegetation, Aerial photography, Data acquisition, Data processing, Spectral reflectance, Fcir stereo imagery, Ecotypes, Ecological distribution.

The fastest and one of the most accurate methods of classifying and delineating inland wetlands and their adjacent upland is through the interpretation of medium-to-large scale (1:12,000 and larger) False Color Infrared stereo imagery. This is accomplished by manual photo interpretation of those readily recognizable properties of inland wetlands and uplands; vegetation types, presence of standing water, soil water content and topography-elevation and slope. In wetlands, vegetation is one of the principal factors causing differences in spectral reflectance. Therefore, noticeable differences in vegetation, vis-a-vis their spectral reflectance, depicted on fcir imagery are directly related to the presence of water, both standing and soil water content. Consequently, the delineation of the boundary between a wetland and its adjacent uplands can clearly be ascertained based upon these differences in spectral reflectance. Classification and delineation of the wetland-upland complex was found most accurately determined in the northeastern and central United States from spring fcir stereo imagery flown at an altitude of 6,000 feet AMT (1:12000). In comparison, the modern methods of field ecology survey were found to be too time consuming, difficult and costly. In particularly fragile ecosystems, comprehensive biological field studies tended to cause considerable physical environmental damage, while the necessary ground truth program covering only a small portion of the area had no adverse impact. (See also W89-08577) (Author's abstract)
W89-08589

HYDROLOGICAL COMPARISON OF LANDSAT TM, LANDSAT MSS AND BLACK & WHITE AERIAL PHOTOGRAPHY,
Aston Univ., Birmingham (England).
For primary bibliographic entry see Field 7A.
W89-08590

APPLICATION OF REMOTE SENSING IN HYDROMORPHOLOGY FOR THIRD WORLD DEVELOPMENT: A RESOURCE DEVELOPMENT STUDY IN PARTS OF HARYANA, INDIA,
Shivaji Univ., Kolhapur (India). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W89-08591

REMOTE SENSING AS A TOOL FOR ASSESSING ENVIRONMENTAL EFFECTS OF HYDROELECTRIC DEVELOPMENT IN A REMOTE RIVER BASIN,
Ontario Hydro, Toronto.
For primary bibliographic entry see Field 7A.
W89-08595

DETERMINATION OF SPECTRAL SIGNATURES OF NATURAL WATER BY OPTICAL AIRBORNE AND SHIPBORNE INSTRUMENTS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
D. Spitzer, and M. R. Wernand.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 771-773, 5 fig, 1 ref.

Descriptors: *Water quality, *Remote sensing, *Data acquisition, *Water sampling, Satellite technology, Spectral analysis, Measuring instruments, Coastal waters, Advanced Spectral Irradiancemeter, Coastal Optical Remote Sensing Airborne Radiometer, Portable Four Channel Radiometer, Reflectance, Suspended solids, Data processing, Multispectral imagery, Optical properties.

The interpretation of remote sensing imagery of water masses requires knowledge on the spectral absorption and back scattering coefficients of the suspended and dissolved materials. Spectral (ir) radiance measurements are to be performed in order to determine the temporally and locally dependent signatures of diverse watertypes. Underwater, airborne and portable instruments ASIR (Advanced Spectral Irradiance meter), CORSAIR (Coastal Optical Remote Sensing Airborne Radiometer) and PCF (Portable Four Channel Radiometer) were developed, calibrated, tested and used for numerous measurements in and above various coastal and oceanic water types. Large sets of data, both optical and sea truth, were collected by taking numerous measurements of underwater reflectance along with sampling of the organic and inorganic concentrations of materials suspended and dissolved in the water. Airborne measurements of the upwelling radiance and collection of multispectral imagery were provided simultaneously with the shipborne operations. The spectral signatures will be calculated from the underwater measurements in combination with the sea truth data using a radiative transfer model. From the absorption and scattering signatures, the algorithms will be determined. The airborne radiometer data will serve for the final tuning of the algorithms as well as for the evaluation of the atmospheric and glitter effects. The airborne imagery can then be processed and interpreted for representative coastal and open sea regions. (See also W89-08577) (White-Reimer-PTT)
W89-08600

SIMPLE ATMOSPHERIC CORRECTION ALGORITHM FOR LANDSAT THEMATIC MAPPER SATELLITE IMAGES,
Koninklijk Museum voor Midden-Afrika, Tervuren (Belgium).
For primary bibliographic entry see Field 7C.
W89-08604

HYDROLOGIC AND OCEANOGRAPHIC APPLICATIONS OF REMOTE SENSING,
Dundee Univ. (Scotland). Physics Lab.
A. P. Cracknell.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Three. A.A. Balkema, Boston. 1986. p 1005-1008, 6 ref.

Descriptors: *Remote sensing, *Data acquisition, *Mapping, *Satellite technology, Computers, Data processing, Landsat imagery, SEASAT, Landsat Thematic Mapper, SPOT HV, Hydrology, Oceanography, Coastal waters, Estuaries, Bathymetry, Manual of Remote Sensing.

A summary of the Manual of Remote Sensing is presented covering the application of remote sensing to hydrology and oceanography. Since the publication of the Manual, a vast amount of oceanographic work has been carried out using the SEASAT data set. SEASAT convinced the oceanographic community of the importance and potential of microwave remote sensing techniques; however, the data processing and interpretation techniques on the ground were not sufficient to handle the quantity of data generated. Significant developments have also been made in airborne lidar for bathymetry work. In oceanography, present routine data from satellites is confined to the optical and infrared parts of the electromagnetic spectrum, and streamlining in data distribution and software for data processing is needed. The new higher-resolution data available from the Landsat Thematic Mapper (TM) and the SPOT HV is being used in estuary and coastal regions. This technology makes it possible to use satellite data for smaller-scale studies that were previously not amenable to study with satellite data. The possibility of serious stereoscopic image data using the SPOT satellite will aid the study of river basins and catchment areas. (See also W89-08609) (White-Reimer-PTT)
W89-08610

MONITORING ENVIRONMENTAL RESOURCES THROUGH NOAA'S POLAR ORBITING SATELLITES,
National Oceanic and Atmospheric Administration, Washington, DC. Assessment and Information Services Center.
J. C. Hock.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Three. A.A. Balkema, Boston. 1986. p 1029-1032, 1 ref.

Descriptors: *Remote sensing, *Data acquisition, *Satellite technology, Resources management, *Monitoring, Environmental effects, Weather, Assessment and Information Services Center (AISC), National Environmental Satellite, Data, and Information Service (NESDIS), National Oceanic and Atmospheric Administration (NOAA), Geography, Agronomy, Economic aspects.

Satellite imagery in combination with surface weather observations can provide a potential tool for evaluating ground and water conditions throughout the world. In order to monitor the economic impacts of anomalous weather, the Assessment and Information Services Center (AISC), of the National Environmental Satellite, Data, and Information Service (NESDIS), National Oceanic and Atmospheric Administration (NOAA) integrates satellite data, geographic information, agronomic, and economic models to monitor both land and marine resources. The AVHRR satellite data are currently used to monitor crop growth in primary grain regions worldwide, desert-locust breeding habitats, the availability of vegetation for grazing animals in Senegal, and the condition of foliage in fire-prone districts. Since 1982, NEDIS has produced weekly composite vegetation index images of Northern and Southern hemispheres. AVHRR data continues to be used to monitor possible climatic changes as well as regional phenomenon such as droughts, desert creep and deforestation. These assessments can provide government officials with an early warning of crop failure in order to mitigate potential climate impacts and reduce climate vulnerability. (See also W89-08609) (White-Reimer-PTT)
W89-08611

WATER-RESOURCES ACTIVITIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1986 TO JUNE 30, 1987,
Geological Survey, Salt Lake City, UT. Water Resources Div.
S. L. Dragos.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-302, April 1988. 64p, 5 fig.

Descriptors: *Publications, *Water resources, *Water resources management, *Utah, Water resources development, Project planning, Budgeting.

This report contains summaries of the progress of water-resources studies in Utah by the U.S. Geological Survey, Water Resources Division, Utah District, from July 1, 1986 to June 30, 1987. The program in Utah during this period consisted of 24 projects; a discussion of each project is given in the main body of the report. Short descriptions are given at the end of the report for six projects proposed to be started on or after July 1987. The following sections outline the basic mission and program of the Water Resources Division, the organizational structure of the Utah District, the distribution of District funding in terms of source of funds and type of activity funded, and the introduction is a list of reports produced by the District for July 1986 to June 1987. (Author's abstract)
W89-08635

TEST OF AN INFRARED LIGHT-EMITTING TURBIDIMETER,
J. J. Szalona.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Report CC, 1984. 18p, 5 fig, 1 tab, 4 ref.

Descriptors: *Turbidimeters, *Measuring instruments, *Suspended sediments, *Infrared radiation, Alluvial deposits, Sediments, Particle size, Clays, Performance evaluation, Optical properties, Turbidity.

A turbidimeter equipped with a pulsed infrared light source was tested for use as a suspended-sediment concentration analyzer. Two alluvial sediments were divided into two groups according to particle size fractions. Various concentrations of each of these groups were analyzed. The instrument readings were nearly proportional to concentration within each group; however, among the groups the proportionality factors varied inversely with particle size. The instrument readings for mixtures of sediment sizes were predicted from the concentration relationships developed for the individual groups. Predicted values compared favorably with measured values. The turbidimeter reached full-scale deflection at a clay concentration of about 100 mg/L. However, the instrument can be adjusted to read higher concentrations. The instrument was not significantly affected by water temperature, dissolved solids, or by sediment color. The instrument did respond, however, to ambient natural or artificial light. Optical properties of the sediment particles also affected the instrument response. This turbidimeter, like other types of turbidimeters, cannot measure sediment concentration unless the particle-size distribution is known. (Author's abstract)
W89-08641

DESCRIPTION AND TEST OF A STRAIGHT-TUBE FLUID-DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION IN STREAMS,
J. J. Szalona.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Progress Report HH, 1986. 29p, 11 fig, 4 ref.

Descriptors: *Density, *Sediment concentration, *Streams, *Measuring instruments, *Gages, *Suspended sediments, Performance evaluation, Streamflow, Particle size, Silt, Sand, Temperature.

An instrument for measuring suspended sediment concentration in streams was designed, constructed, and tested. The instrument is designed to be suspended in a stream while flowing water passes through a tube within. The tube is vibrated and assumes a frequency dependent on the sediment concentration in the water. Sediment in the silt and fine-sand ranges was tested. The instrument had a linear response and a sensitivity of about 770 mg/L/microsecond change in period of vibration for both sediments. Tests with sugar water produced similar results. Other significant findings are that the instrument responds nearly linearly to temperature, at the rate of 1.69 microsecond for every degrees C. This held true over the range of 1.0 to 40.2 degrees C. Flow through the tube decreased the vibrational period 10 microsecond/m/sec increase in flow velocity (in the range of 1 to 2 m/sec). Pressurized helium gas proved effective in transferring heat from the interior of the instrument; as a result, the instrument can adjust to temperature changes more quickly (Author's abstract)
W89-08642

KANSAS GROUND-WATER OBSERVATION-WELL NETWORK, 1983,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08660

STATISTICAL SUMMARY OF DATA FROM THE U. S. GEOLOGICAL SURVEY'S NATIONAL WATER QUALITY NETWORKS,
Geological Survey, Reston, VA. Water Resources Div.
R. A. Smith, and R. B. Alexander.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-533, 1983. 30p, 3 tab, 12 ref.

Descriptors: *Statistics, *Water quality, *Networks, Data collections, Streamflow, Catchment areas, Inorganic compounds, Nutrients, Trace metals.

The U.S. Geological Survey Operates two nationwide networks to monitor water quality, the National Hydrologic Bench-Mark Network and the National Stream Quality Accounting Network (NASQAN). The Bench-Mark network is composed of 51 stations in small drainage basins which are as close as possible to their natural state, with no human influence and little likelihood of future development. Stations in the NASQAN program are located to monitor flow from accounting units (subregional drainage basins) which collectively encompass the entire land surface of the nation. Data collected at both networks include streamflow, concentrations of major inorganic constituents, nutrients, and trace metals. The goals of the two water quality sampling programs include the determination of mean constituent concentrations and transport rates as well as the analysis of long-term trends in those variables. This report presents a station-by-station statistical summary of data from the two networks for the period 1974 through 1981. (Author's abstract)
W89-08661

COST EFFECTIVENESS OF STREAM-GAGING PROGRAM IN MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4293, 1985. 72p, 12 fig, 13 tab, 17 ref.

Descriptors: *Cost analysis, *Stream gages, *Data acquisition, *Michigan, *Gaging stations, Statistical analysis, Stream discharge, Project planning, Economic aspects, Costs, Budgets.

Data uses and funding sources were identified for the 129 continuous gaging stations being operated in Michigan as of 1984. One gaging station was identified as having insufficient reason to continue its operation. Several stations were identified for reactivation, should funds become available, because of insufficiencies in the data network. Alternative methods of developing streamflow information based on routing and regression analyses were investigated for 10 stations. However, no station records were reproduced with sufficient accuracy to replace conventional gaging practices. A cost-effectiveness analysis of the data collection procedure for the ice-free season was conducted using a Kalman-filter analysis. To define missing record characteristics, cross-correlation coefficients and coefficients of variation were computed at stations on the basis of daily mean discharge. Discharge measurement data were used to describe the gage/discharge rating stability at each station. The results of the cost-effectiveness analysis for a 9-month ice-free season show that the current policy of visiting most stations on a fixed servicing schedule once every 6 weeks results in an average standard error of 12.1% for the current $718,100 budget. By adopting a flexible servicing schedule, the average standard error could be reduced to 11.1%. Alternatively, the budget could be reduced to $700,200 while maintaining the current level of accuracy. A minimum budget of $680,200 is needed to operate the 129-gaging-station program; a budget less than this would not permit proper service and maintenance of stations. At the minimum budget, the average standard error would be 14.4%. A budget of $789,900 (the maximum analyzed) would result in a decrease in the average standard error to 9.07%. Owing to continual changes in the composition of the network and the changes in the uncertainties of streamflow accuracy at individual stations, the cost-effectiveness analysis will need to be updated regularly if it is to be used as a management tool. Cost of these updates need to be considered in decisions concerning the feasibility of flexible servicing schedules. (Author's abstract)
W89-08672

DEVELOPMENT OF A WATER-USE DATA SYSTEM IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08693

DEVELOPMENT AND TESTING OF HIGHWAY STORM-SEWER FLOW MEASUREMENT AND RECORDING SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
F. A. Kilpatrick, W. R. Kaehrle, J. Hardee, E. H. Cordes, and M. N. Landers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4111, (1985). 98p, 63 fig, 13 tab, 51 ref.

Descriptors: *Measuring instruments, *Flow characteristics, *Storm sewers, *Flow profiles, *Flow meters, *Discharge measurement, *Gaging, Performance evaluation, Field tests, Highways.

A comprehensive study and development of measuring instruments and techniques for measuring all components of flow in a storm-sewer drainage system was undertaken by the U.S. Geological Survey under the sponsorship of the Federal Highway Administration. The study involved laboratory and field calibration and testing of measuring flumes, pipe insert meters, weirs, electromagnetic velocity meters as well as the development and calibration of pneumatic-bubbler pressure transducer head measuring systems. Tracer-dilution and acoustic flow meter measurements were used in field verification tests. A single micrologger was used to record data from all the above instruments as well as from a tipping-bucket rain gage and also to activate on command the electromagnetic velocity meter and tracer-dilution systems. (Author's abstract)
W89-08721

SATELLITE DATA-RELAY ACTIVITIES IN ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
F. C. Boner, J. W. H. Blee, and W. G. Shope.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4158, 1985. 22p, 4 fig, 6 tab.

Descriptors: *Streamflow, *Arizona, *Data acquisition, *Satellite technology, Flow profiles, Water supply, Flood forecasting, Remote sensing, Telemetry.

The U.S. Geological Survey (USGS) Arizona District collects data from automated streamflow stations for a wide variety of uses. Data from these stations are provided to Federal, State, and local agencies that have a responsibility to issue flood warnings; to generate forecasts of water availability; to monitor flow to insure compliance with treaties and other legal mandates; and to manage reservoirs for hydropower, flood abatement, and municipal and irrigation water supply. In the mid-1970's, the escalation of data collection costs and a need for more timely data led the Arizona District to examine alternatives for remote data acquisition. On the basis of successful data communications experiments with NASA's Landsat satellite, an operational system for satellite-data relay was developed in 1976 using the National Oceanic and Atmospheric Administrations's (NOAA) Geostationary Operational Environmental Satellite (GOES). A total of 62 data collection platforms (DCP's) was operated in 1983. Satellite telemetry operations are controlled at the remote data-collection stations by small battery-operated data collection platforms. The DCP's periodically collect data from the sensors, store the data in computer memory, and at preset times transmit the data to the GOES satellite. The satellite retransmits the data to Earth where a ground-receive station transmits or transfers the data by land communications to the USGS computer in Reston, Virginia, for processing. The satellite relay transfers the data from sensor to computer in minutes; therefore, the data are available to users on a near real-time basis. (Author's abstract)
W89-08738

WATER-QUALITY APPRAISAL OF NASQAN STATIONS BELOW IMPOUNDMENTS, EASTERN TENNESSEE,
Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08750

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAMS IN NEW HAMPSHIRE AND VERMONT,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08751

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. A. Stewart, R. L. Miller, and G. K. Butch.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4343, 1986. 92p, 9 fig, 13 tab, 25 ref.

Descriptors: *Cost-benefit analysis, *Stream gages, *Streamflow, *Data acquisition, *Indiana, Statistical analysis, Model studies, Gaging stations, Management planning, Budgeting, Surface water.

Analysis of the stream gaging program in Indiana was divided into three phases. The first phase involved collecting information concerning the data need and the funding source for each of the 173 surface water stations in Indiana. The second phase used alternate methods to produce streamflow records at selected sites. Statistical models were used to generate stream flow data for three gaging stations. In addition, flow routing models were used at two of the sites. Daily discharges produced from models did not meet the established accuracy criteria and, therefore, these methods should not replace stream gaging procedures at those gaging stations. The third phase of the study determined the uncertainty of the rating and the error at individual gaging stations, and optimized travel routes and frequency of visits to gaging stations. The annual budget, in 1983 dollars, for operating the stream gaging program in Indiana is $823,000. The average standard error of instantaneous discharge for all continuous record gaging stations is 25.3%. A budget of $800,000 could maintain this level of accuracy if stream gaging stations were visited according to phase III results. A minimum budget of $790,000 is required to operate the gaging network. At this budget, the average standard error of instantaneous discharge would be 27.7%. A maximum budget of $1,000,000 was simulated in the analysis and the average standard error of instantaneous discharge was reduced to 16.8%. (Author's abstract)
W89-08760

COST-EFFECTIVENESS OF THE FEDERAL STREAM-GAGING PROGRAM IN VIRGINIA,
Geological Survey, Towson, MD. Water Resources Div.
D. H. Carpenter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4345, 1985. 72p, 10 fig, 13 tab, 17 ref.

Descriptors: *Cost-benefit analysis, *Stream gages, *Streamflow, *Data acquisition, *Virginia, Statistical analysis, Model studies, Gaging stations, Management planning, Budgeting, Surface water.

Data uses and funding sources were identified for the 77 continuous stream gages currently being operated in Virginia by the U.S. Geological Survey with a budget of $446,000. Two stream gages were identified as not being used sufficiently to warrant continuing their operation. Operation of these stations should be considered for discontinuation. Data collected at two other stations were identified as having uses primarily related to short-term studies; these stations should also be considered for discontinuation at the end of the data collection phases of the studies. The remaining 73 stations should be kept in the program for the foreseeable future. The current policy for operation of the 77-station program requires a budget of $446,000/yr. The average standard error of estimation of streamflow records is 10.1%. It was shown that this overall level of accuracy at the 77 sites could be maintained with a budget of $430,500 if resources were redistributed among the gages. A minimum budget of $428,500 is required to operate the 77-gage program; a smaller budget would not permit proper service and maintenance of the gages and recorders. At the minimum budget, with optimized operation, the average standard error would be 10.4%. The maximum budget analyzed was $650,000, which resulted in an average standard error of 5.5%. The study indicates that a major component of error is caused by lost or missing data. If perfect equipment were available, the standard error for the current program and budget could be reduced to 7.6%. This also can be interpreted to mean that the streamflow data have a standard error of this magnitude during times when the equipment is operating properly. (Author's abstract)
W89-08761

DETERMINATION OF GEOHYDROLOGIC FRAMEWORK AND EXTENT OF GROUNDWATER CONTAMINATION USING SURFACE GEOPHYSICAL TECHNIQUES AT PICATINNY ARSENAL, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
P. Lacombe, B. P. Sargent, P. T. Harte, and E. F. Vowinkel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4051, 1986. 31p, 11 fig, 3 tab, 16 ref.

Descriptors: *Geohydrology, *Groundwater movement, *Groundwater pollution, *Picatinny Arsenal, *New Jersey, *Path of pollutants, *Data acquisition, Electromagnetic waves, Conductivity, Seismology, Military reservations, Resistivity.

Seismic-refraction, electric-resistivity sounding, and electromagnetic conductivity techniques were used to determine the geohydrologic framework and extent of groundwater contamination at Picatinny Arsenal in northern New Jersey. The area studied encompasses about 4 sq mi at the southern end of the Arsenal. The bedrock surface beneath the glacial sediments was delineated by seismic-refraction techniques. Data for 12 seismic lines were collected using a 12-channel engineering seismograph. Competent bedrock crops out on both sides of the valley, but is about 290 ft below land surface in the deepest part of the topographic valley. Where the exposed bedrock surface forms steep slopes on the valley side, it remains steep below the valley fill. Likewise, gentle bedrock valley slopes have gentle subsurface slopes. The deepest part of the bedrock valley is along the southern extension of the Green Pond fault. The electric-resistivity sounding technique was used to determine the sediment types. Data were collected from four sites using the offset Wenner electrode configuration. Below the surface layer, the sediments have apparent and computed resistivity values of 120 to 170 ohm-meters. These values correspond to a saturated fine-grained sediment such as silt or interbedded sand and clay. Groundwater contamination was by electromagnetic conductivity techniques using transmitting and receiving coils separated by 32.8 ft and 12 ft. Thirteen sites have apparent conductivity values exceeding 15 millimhos/m. Of these, seven sites indicate groundwater contamination from a variety of sources including a sanitary landfill, pyrotechnic testing ground, burning area, former domestic sewage field, salt storage facility, hazardous waste disposal lagoon, sewage treatment plant, and fertilizer storage shed. Three areas underlain by clay or muck are interpreted to be free of contamination. (Author's abstract)
W89-08799

GEOPHYSICAL WELL-LOG ANALYSIS OF FRACTURED CRYSTALLINE ROCKS AT EAST BULL LAKE, ONTARIO, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08800

SELECTED METHODS FOR DISSOLVED IRON (II, III) AND DISSOLVED SULFIDE (-II) DETERMINATIONS IN GEOTHERMAL WATERS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-08811

EVALUATION OF SURFACE GEOPHYSICAL METHODS FOR COLLECTION OF HYDROGEOLOGIC DATA IN THE NEBRASKA SAND HILLS REGION,
Geological Survey, Lincoln, NE. Water Resources Div.
M. J. Ellis, and R. A. Hiergesell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4195, 1985. 56p, 22 fig, 8 tab, 30 ref.

Descriptors: *Nebraska, *Seismic properties, *Electrical studies, *Data acquisition, *Geophysics, *Geohydrology, Seismic properties, Electrical properties, Groundwater budget, Water table, Aquifers, Performance evaluation, Data acquisition, Subsurface mapping.

The practicality of using surface geophysical methods for obtaining geohydrologic data in the Nebraska Sand Hills region was studied during the summer of 1984. Seismic refraction and electrical-resistivity equipment were used, because an evaluation of geohydrologic data indicated that results of surveys made with this equipment probably would yield the most useful data. The study area, which included parts of Garfield, Holt, and Wheeler Counties, was selected because it is geohydrologically representative of the eastern part of the Sand Hills region, and because sufficient geohydrologic data were available for use in evaluating the results of geophysical surveys. Geophysical methods were evaluated for their ability to consistently detect selected geohydrologic horizons. These horizons in descending order, are: the water table, the top of

Quaternary silt beds, the top of Quaternary sand and gravel beds, the top of the Tertiary Ogallala Formation, and the top of the Cretaceous Pierre Shale. The top of the Pierre Shale generally is the base of the aquifer, which consists of all of the 500 to 700 ft of overlying deposits. Evaluations of the geophysical data indicate that seismic refraction surveys are best suited for determining the depth to the water table, but are not effective in studying beds below the water table. Vertical electrical soundings provided data on the depth to water table and the top of the silt beds. Available geohydrologic data, however, indicate that with some changes in data collection or interpretation techniques, it may be possible to obtain information on the top of the sand and gravel deposits, the top of the Ogallala Formation, and the top of the Pierre Shale with vertical electrical soundings. Use of either geophysical method could enhance the results of geohydrologic investigations in the Nebraska Sand Hills region. (Author's abstract)
W89-08818

COST EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
A. C. Barker, B. C. Wright, and C. S. Bennett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4210, 1985. 77p, 9 fig, 13 tab, 18 ref.

Descriptors: *Cost-benefit analysis, *Cost analysis, *Stream gages, *South Carolina, *Project planning, *Streamflow, *Data acquisition, Budgeting, Economic aspects.

The cost effectiveness of the stream-gaging program in South Carolina was documented for the 1983 water yr. Data uses and funding sources were identified for the 76 continuous stream gages currently being operated in South Carolina. The budget of $422,200 for collecting and analyzing streamflow data also includes the cost of operating stage-only and crest-stage stations. The streamflow records for one stream gage can be determined by alternate, less costly methods, and should be discontinued. The remaining 75 stations should be maintained in the program for the foreseeable future. The current policy for the operation of the 75 stations including the crest-stage and stage-only stations would require a budget of $417,200/yr. The average standard error of estimation of streamflow records is 16.9% for the present budget with missing record included. However, the standard error of estimation would decrease to 8.5% if complete streamflow records could be obtained. It was shown that the average standard error of estimation of 16.9% could be obtained at the 75 sites with a budget of approximately $395,000 if the gaging resources were redistributed among the gages. A minimum budget of $383,500 is required to operate the program; a budget less than this does not permit proper service and maintenance of the gages and recorders. At the minimum budget, the average standard error is 18.6%. The maximum budget analyzed was $850,000, which resulted in an average standard error of 7.6%. (Author's abstract)
W89-08828

REVIEW OF SOME OF THE PHYSICAL, CHEMICAL AND ISOTOPIC TECHNIQUES AVAILABLE FOR ESTIMATING GROUNDWATER RECHARGE,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2F.
W89-08834

EVAPORATION IN ARID AND SEMI-ARID REGIONS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Physics and Meteorology.
For primary bibliographic entry see Field 2D.
W89-08835

SATELLITE REMOTE SENSING AND ENERGY BALANCE MODELLING FOR WATER BALANCE ASSESSMENT IN SEMI-ARID REGIONS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W89-08836

SOLUTE PROFILE TECHNIQUES FOR RECHARGE ESTIMATION IN SEMI-ARID AND ARID TERRAIN,
British Geological Survey, Edinburgh (Scotland). Hydrogeology Research Group.
For primary bibliographic entry see Field 2F.
W89-08839

NATURAL RECHARGE MEASUREMENTS IN THE HARD ROCK REGIONS OF SEMI-ARID INDIA USING TRITIUM INJECTION-A REVIEW,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 2F.
W89-08841

COMPARISON OF RECHARGE ESTIMATES FROM INJECTED TRITIUM TECHNIQUE AND REGIONAL HYDROLOGICAL MODELLING IN THE CASE OF A GRANITIC BASIN IN SEMI-ARID INDIA,
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W89-08842

STUDIES ON NATURAL RECHARGE TO THE GROUNDWATER BY ISOTOPE TECHNIQUES IN ARID WESTERN RAJASTHAN, INDIA,
Indian Agricultural Research Inst., New Delhi. Nuclear Research Lab.
For primary bibliographic entry see Field 2F.
W89-08843

PRINCIPLES OF INVERSE MODELLING FOR ESTIMATION OF RECHARGE FROM HYDRAULIC HEAD,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2F.
W89-08846

ST. HELENS BLAST RELATED SEDIMENTATION MODELING AND PLANNING REALITIES IN THE TOUTLE/COWLITZ/COLUMBIA RIVER SYSTEM,
Portland State Univ., OR. Dept. of Urban Studies and Planning.
For primary bibliographic entry see Field 2J.
W89-08891

CENTRIFUGE MODELING OF RIVER BANK FAILURES DUE TO SEEPAGE FLOW,
Utsunomiya Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08897

BRAZILIAN ELECTRIC SECTOR EXPERIENCE IN FLOOD CONTROL,
ELETROBRAS, Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 4A.
W89-08898

ADVANCED TECHNIQUE IN DATA COLLECTION IN WATER RESOURCES PLANNING, WITH EMPHASIS ON THE ROLE OF SATELLITE IMAGERY,
Bangladesh Space Research and Remote Sensing Organization, Dacca.
F. A. Khan.
IN: Water Resources Policy for Asia. A.A. Balkema, Rotterdam, Netherlands. 1987. p 541-547.

Descriptors: *Data acquisition, *Measuring instruments, *Water resources data, *Satellite technology, *Remote sensing, *Hydrologic data collections, *Developing countries, *Weather data collections, Flood forecasting, Agriculture, Bangladesh, Mapping, Fish farming, Resources management.

The Bangladesh Space Research and Remote Sensing Organization (SPARRSO) has been recording satellite data for hydrology, agriculture, environment, and crop monitoring. An Agro-Climatic Environment Monitoring System has been installed at SPARRSO with two VAX 11/750 computers and IIS Mod. 75 Image Processors. This system is synchronized with ten Data Collection Platforms (DCP) installed at different locations in the country as well as in the Bay of Bengal. Each station has different sensors for the measurements of river stage, precipitation, humidity, wind speed, air temperature, salinity, etc. Measurements from the DCP stations are received regularly by SPARRSO via NOAA satellites. These data are fed directly to the VAX computer for processing. They can also be disseminated to other agencies via microwave transmitters or by telephone line or stored on tapes or diskettes for microprocessor usage. The DCP system shows great advantages for areas which are inaccessible or difficult to visit frequently. Continued use of satellite imagery is providing data for mapping of water bodies for pisciculture, river course monitoring, flood forecasting, sea level variations, dry season condition of waterpools, etc., to provide up-to-date information for hydrology and resources management. (See also W89-08899) (Sand-PTT)
W89-08931

RIVER BED GRAVELS: SAMPLING AND ANALYSIS,
British Columbia Univ., Vancouver. Dept. of Geography.
M. A. Church, D. G. McLean, and J. F. Wolcott.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 43-78, 3 tab, 17 fig, 50 ref.

Descriptors: *Particle size, *Bed-load samples, *River beds, *Gravel, *Streambeds, Sampling, Bottom sampling, Data acquisition, Data processing, Statistical analysis, Surface sampling, Subsurface sampling.

The characterization of coarse bed material in rivers is difficult because the range of grain sizes is so wide that is impractical to maintain a single method of measurement. Surface sampling techniques include grid or transect, areal, and volumetric. Size distribution for the sample is determined on a frequency-by-number basis to ensure that the sample is properly constituted for statistical treatment. Since mixtures of clastic material frequently display variance proportional to the mean size, for statistical purposes an appropriate transformation is applied to achieve constant variance. Surface materials may also be sampled photographically by measuring grain size on the photograph at grid-selected positions. Subsurface material is almost always a bulk sample collected by a shovel or scoop, then size graded in square mesh sieves and apportioned by weight. The established standards for sampling mineral aggregates are inconsistent and lead to non-equivalent results. The formal conversion factors designed to make different samples equivalent are controversial. Because bed material samples are drawn from a very large and variable population, statistical procedures are used for interpretation. Since statistics are based on number counts, this procedure may be applied within samples when individual clasts are measured. However, customary sieve procedures yield frequency by weight, which is not a well-conditioned statistical entity, and transformations are unhelpful in practice since the numbers become absurdly large for small clasts. Methods suggested for comparing surface and subsurface samples include: (1) grid-by-number of surface layer vs volumetric subsurface bed; (2) areal sample of surface layer vs volumetric subsurface bed; and (3) volumetric surface bed vs volumetric subsurface bed. (See also W89-08934) (White-Reimer-PTT)

W89-08937

DETERMINING TRUE DEPTH OF SAMPLERS SUSPENDED IN DEEP, SWIFT RIVERS,
J. P. Beverage.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Report GG, 1987. 56p, 11 fig, 4 tab, 17 ref, 2 append.

Descriptors: *Streamflow, *Samplers, *Sampling, *Flow velocity, Water depth, *Measuring instruments, *River flow, *Data acquisition, Computer programs, Drag.

A sampler lowered into flowing water by cable will be pushed downstream by the water. Cable profile were analyzed and a computer program devised to assist in testing sampler design modifications. The program shows merit for use in predicting the location of a sampler or sounding weight in deep, swift rivers, and for quantifying theoretical suspended sediment sampling errors. The BASIC program computes wetted suspension-cable length, cable tension, downstream drift, and the vertical angle of the cable at the surface. The program requires the total depth, mean velocity, Manning's roughness, and the wire drag coefficient (CDW). The forces of the sampler are computed and then balanced on each segment of cable from the sampler to the surface. Values of CDW of almost 5 were needed to match field data for sounding weights towed in a lake. The error in suspended sediment concentration caused by nonlinearity of the sampler's path through the vertical quite small for a limited set of conditions. Measurements that require accurate depth placement need to use suitable instrumentation; depth sensors, heavy samplers and a two-transducer fathometer scheme are suggested. (Author's abstract)
W89-08978

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1986,
Geological Survey, Reston, VA. Water Resources Div.
B. K. Gilbert, and W. B. Mann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-27, 1987. 38p, 2 fig, 3 tab, 5 ref, append.

Descriptors: *Data collections, *Water resources data, *US Geological Survey, *Economic aspects, *Hydrologic data collections, Project planning, Budgeting, Groundwater pollution.

The U.S. Geological Survey's Federal-State Cooperative Water Resources Program has been in operation for 91 years as of fiscal year (FY) 1986. Hydrologic data collection and interpretive investigations are underway in every State, Puerto Rico, and several territories in cooperation with more than 900 State, regional and local agencies. Federal funds amounted to $49.8 million in this 50-50 matching activity. Total funding was about $106 million, which included $6.9 million furnished by cooperating agencies on an unmatched basis. The Cooperative Program comprised more than 40% of the overall FY 1986 budget of the Survey's Water Resources Division. The areas of principal emphasis during the year included groundwater contamination, stream quality, water supply and demand, and hydrologic hazards. Information is presented on program priorities and investigations implemented under the merit proposal process. The status of water use information activities, which are being carried out in 48 states and Puerto Rico is reviewed briefly. Standard methods for collecting the data are being developed. Each state has a computerized State Water-Use Data System for storage and retrieval of water-use data for individual users or facilities. (Lantz-PTT)
W89-08981

WATER-QUALITY DATA-COLLECTION ACTIVITIES IN COLORADO AND OHIO: PHASE II--EVALUATION OF 1984 FIELD AND LABORATORY QUALITY-ASSURANCE PRACTICES,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress, T. H. Chaney, D. Myers, J. M. Norris, and J. Hren.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-33, 1987. 70p, 3 fig, 10 tab, 42 ref.

Descriptors: *Water data, *Quality assurance, *Data acquisition, *Project planning, Colorado, Ohio, Performance evaluation, State jurisdiction, Federal jurisdiction, Local governments, Water quality management.

Serious questions have been raised by Congress about the usefulness of water quality data for addressing issues of regional and national scope and, especially, for characterizing the current quality of the Nation's streams and groundwater. In response, the U.S. Geological Survey conducted a pilot study in Colorado and Ohio to: (1) determine the characteristics of current (1984) water quality data collection activities of Federal, regional, State, and local agencies, and academic institutions; and (2) determine how well the data from these activities, collected for various purposes and using different procedures, can be used to improve the ability to answer major broad scope questions, such as: what are (or were) natural or near-natural water quality conditions; what are existing water quality conditions; and, how water quality has changed and how the changes relate to human activities. Colorado and Ohio were chosen for the pilot study largely because they represent regions with different types of water quality concerns and programs. The study has been divided into three phases, the objectives of which are: Phase I - Inventory water quality data collection programs, including costs, and identify those programs that met a set of broad criteria for producing data that are potentially appropriate for water quality assessments of regional and national scope. Phase II - Evaluate the quality assurance of field and laboratory procedures used in producing the data from programs that met the broad criteria of Phase I. Phase III - Compile the qualifying data and evaluate the adequacy of this data base for addressing selected water quality questions of regional and national scope. (Author's abstract)
W89-08984

PRELIMINARY HYDROLOGIC DATA FOR WELLS TESTED IN NASH DRAW, NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08985

FORWARD-MODELING COMPUTER PROGRAM FOR THE INDUCTIVE ELECTROMAGNETIC GROUND-CONDUCTIVITY METHOD: EM34.FOR,
Geological Survey, Hartford, CT. Water Resources Div.
D. G. Grantham, K. Ellefsen, and F. P. Haeni.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-213-A, 1987. 43p, 7 fig, 5 tab, 25 ref, append.

Descriptors: *Geophysics, *Groundwater, *Computer programs, *Electromagnetic waves, *Measuring instruments, *Conductivity, Groundwater movement, Path of pollutants, Groundwater pollution.

An interactive microcomputer program, EM34.FOR, that calculates the apparent conductivity that would be measured by a two-coil inductive electromagnetic instrument at the surface of the Earth for a given sequence of conductive horizontal layers. The operation of the electromagnetic instrument and the approximations upon which the instrument is based are described. In groundwater applications, a typical problem might be to determine the extent of groundwater contamination from a landfill by defining the lateral and vertical dimensions of the volume of groundwater that has a conductivity higher than background levels. Included are detailed instructions and an example for using the program, and the assumptions made in developing the code. A brief discussion of the theory behind the program algorithm is included as an appendix. The program code listing is included as an attachment. (Lantz-PTT)
W89-08988

COLUMBIA GLACIER, ALASKA: PHOTOGRAMMETRY DATA SET: 1981-82 AND 1984-85,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W89-08990

SURFACE WATER-QUALITY ASSESSMENT OF THE KENTUCKY RIVER BASIN, KENTUCKY: PROJECTION DESCRIPTION,
Geological Survey, Louisville, KY. Water Resources Div.
K. D. White, J. L. Smoot, J. K. Jackson, and A. F. Choquette.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-234, 1987. 39p, 11 fig, 4 tab, 28 ref.

Descriptors: *Water pollution sources, *Land use, *Environmental effects, *Kentucky River, Kentucky, Agriculture, Forestry, Oil industry, Coal mining, Monitoring, Sedimentation, Wastewater disposal, Data acquisition.

In April 1986, the U.S. Geological Survey began the National Water Quality Assessment Program, which at present (1987) is in a pilot phase in which assessment concepts and approaches are being tested and modified to prepare for full implementation of the program in the future. Seven pilot projects (four surface water projects and three groundwater projects) have been started. The preliminary plans for the surface water quality assessment of the Kentucky River basin pilot project are described. The Kentucky River basin drains an area of approximately 7,000 sq mi in east central Kentucky and is underlain by rocks that range in composition from limestone to sandstone and shale. Because greater than 95% of the basin population relies on surface water, surface water quality is of great concern. Land use practices that affect the surface water quality in the basin include agriculture, forestry, oil and gas production, coal mining, and urbanization. Water quality concerns resulting from the various land uses include the effects of: oil and gas field brine discharges; agricultural chemicals; sedimentation caused by coal mining; and trace element impacts from industrial and urban environments. Assessment activity is designed to occur over a 9-year period of time. During the first 3-year period of the cycle, concentrated data acquisition and interpretation will occur. For the next 6 years, sample collection will occur at a much lower level of intensity to document the occurrence of any gross changes in water quality. This 9-year cycle will then be repeated. Historical data will be evaluated to provide, to the extent possible, a description of existing and past trends in water quality conditions and to develop conceptual models that relate the observed conditions to the sources and causes, both natural and human-controlled. New data will be collected to verify the water quality conditions documented by historic data, to track long-term trends in water quality, to intensify temporal and spatial sampling densities, and to improve the understanding of the relations between water quality conditions and causative factors. (Lantz-PTT)
W89-08993

OPERATION OF HYDROLOGIC DATA COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1987,
Geological Survey, Reston, VA. Water Resources Div.
A. Condes de la Torre.
Available from Books and Open File Report Sec-

tion, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-563, 1987. 42p, 34 fig, 1 tab, 5 ref.

Descriptors: *Water resources data, *Hydrologic data, *Data acquisition, *Management planning, Streams, Reservoirs, Lakes, Groundwater level, Sedimentation, Precipitation, Satellite technology, Telemetry, Remote sensing, Budgeting.

The U.S. Geological Survey operates hydrologic data collection stations nationwide which serve the needs of all levels of government, the private sector, and the general public, for water resources information. During fiscal year 1987, surface water discharge was determined at 10,624 stations; stage data on streams, reservoirs, and lakes were recorded at 1,806 stations; and various surface water quality characteristics were determined at 2,901 stations. In addition, groundwater levels were measured at 32,588 stations, and the quality of groundwater was determined at 9,120 stations. Data on sediment were collected daily at 174 stations and on a periodic basis at 878 stations. Information on precipitation quantity was collected at 909 stations, and the quality of precipitation was analyzed at 78 stations. Data collection platforms for satellite telemetry of hydrologic information were used at 2,292 Geological Survey stations. Funding for the hydrologic stations was derived, either solely or from a combination, from three major sources - the Geological Survey's Federal Program appropriation, the Federal-State Cooperative Program, and reimbursements from other Federal agencies. The number of hydrologic stations operated by the Geological Survey declined from fiscal year 1983 to 1987. The number of surface water discharge stations were reduced by 452 stations; surface water quality stations declined by 925 stations; groundwater level stations declined by 1,051 stations; while groundwater quality stations increased by 1,472 stations. (Author's abstract)
W89-08996

SURFACE- AND GROUND-WATER QUALITY DATA AT SELECTED LANDFILL SITES IN MECKLENBURG COUNTY, NORTH CAROLINA, 1980-86,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08997

SOME ASPECTS OF U.S. GEOLOGICAL SURVEY ACTIVITIES RELATED TO THE EFFECTS OF CONTAMINANTS ON WATER RESOURCES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-09008

INTERACTIVE PROGRAM TO DISPLAY USER-GENERATED OR FILE-BASED MAPS ON A PERSONAL COMPUTER MONITOR,
Geological Survey, Lakewood, CO. Water Resources Div.
W. H. Langer, and R. W. Stephens.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-676, (1987.) 66p, 3 fig, 4 append.

Descriptors: *Data interpretation, *Computer programs, *Maps, *Data processing, Geologic mapping, Computers.

PC MAP-MAKER is an ADVANCED BASIC program written to provide users of IBM XT, IBM AT, and compatible computers with a straightforward, flexible method to display geographical data on a color or monochrome PC (personal computer) monitor. Data can be political boundaries such as State and county boundaries; natural curvilinear features such as rivers, drainage areas, and geological contacts; and points such as well locations and mineral localities. Essentially any point defined by a latitude and longitude and any line defined by a series of latitude and longitude values can be displayed using the program. PC MAP MAKER allows users to view tabular data from U.S. Geological Survey files such as WATSTORE (National Water Data Storage and Retrieval System) in a map format in a time much shorter than required by sending the data to a line plotter. The screen image can be saved to disk for recall at a later date, and hard copies can be printed with a dot matrix printer. The program is user-friendly, using menus or prompts to guide user input. It is fully documented and structured to allow the user to tailor the program to the user's specific needs. The documentation includes a tutorial designed to introduce users to the capabilities of the program using the State of Colorado as a demonstration map area. (Author's abstract)
W89-09009

FLUOROMETRIC PROCEDURES FOR DYE TRACING,
J. F. Wilson, E. D. Cobb, and F. A. Kilpatrick.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Techniques of Water-Resources Investigations, Book 3: Applications of Hydraulics, Chapter A12, 1986. 34p, 13 fig, 3 tab, 35 ref.

Descriptors: *Streamflow measurement, *Dye releases, *Fluorometry, *Dyes, *Tracers, *Groundwater movement, Discharge, Aeration, Manuals, Measuring instruments, Fluorometers, Flow profiles.

This manual describes the current fluorometric procedures used by the U.S. Geological Survey in dye tracer studies such as time of travel, dispersion, reaeration, and dilution-type discharge measurements. The advantages of dye tracing are (1) low detection and measurement limits and (2) simplicity and accuracy in measuring dye tracer concentrations using fluorometric techniques. The manual contains necessary background information about fluorescence, dyes, and fluorometers and a description of fluorometric operation and calibration procedures as a guide for laboratory and field use. The background information should be useful to anyone wishing to experiment with dyes, fluorometer components, or procedures different from those described. In addition, a brief section of aerial photography is included because of its possible use to supplement ground-level fluorometry. (See also W86-03043) (Author's abstract)
W89-09013

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-09031

EVALUATION OF WET-LINE DEPTH-CORRECTION METHODS FOR CABLE-SUSPENDED CURRENT METERS,
Geological Survey, NSTL Station, MS. Water Resources Div.
W. F. Coon, and J. C. Futrell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4329, 1986. 31p, 17 fig, 4 tab, 2 ref.

Descriptors: *Stream gages, *Gaging, *Streamflow measurement, *Data acquisition, *Measuring instruments, *Current meters, Sounding, Water depth, Performance evaluation.

Wet-line depth corrections for cable-suspended current meter and weight not perpendicular to the water surface have been evaluated using cable-suspended weights towed by a boat in still water. A fathometer was used to track a Columbus sounding weight and to record its actual depth for several apparent depths, weight sizes, and towed velocities. Cable strumming, tension, and weight veer are noted. Results of this study suggest possible differences between observed depth corrections and corrections obtained from the wet-line correction table currently in use. These differences may have resulted from test conditions which deviated from the inherent assumptions of the wet-line table: (1) drag on the weight in the sounding position at the bottom of a stream can be neglected; and (2) the distribution of horizontal drag on the sounding line is in accordance with the variation of velocity with depth. Observed depth corrections were compared to wet-line table values used for determining the 0.8-depth position of the sounding weight under these conditions; the results indicate that questionable differences exist. (Lantz-PTT)
W89-09032

WATER-RESOURCES STUDIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1983, TO JUNE 30, 1984,
Geological Survey, Salt Lake City, UT.
For primary bibliographic entry see Field 2E.
W89-09060

INSTRUMENTATION FOR MEASURING AND RECORDING STREAMFLOW DATA AT RIVER-CONTROL STRUCTURES.
Geological Survey, NSTL Station, MS. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-872, 1983. 29p, 9 fig, 2 tab, 4 ref.

Descriptors: *River-control structures, *Flow measurement, *Streamflow, *Measuring instruments, *River flow, Hydraulic structures, Data acquisition, Hydrologic data, Monitoring, Turbines, Locks, Pressure-measuring instruments, Manometers, Dams.

Instrumentation was developed in the mid to late 60's to resolve the dilemma of intolerably high percentages of missing streamflow records on certain large and highly controlled streams in industrialized parts of the United States. Analysis of the field situation at specific problem sites quickly suggested that conventional stream gaging techniques should be supplanted by new instruments, designed to measure key hydraulic data at the nearest stream control structures. The key data were found universally to include some combination of a length measurement to specify the vertical height of a gate opening in a dam; measurement of pressure head differential in a turbine; a count of lockages; and precise measurement of time, to give one master reference scale to which all measurements could be keyed. The instruments designed to collect such key data are the shaft position digitizer, the shaft output follower, the STACOM manometer, the lock pressure switch, and the digital data collection console. Although their design was prompted by the need to collect data at river control structures their potential for field use is not that restrictive. Several of these instruments have already found widespread use in the hydrologic data collection program at large. In the 12-1/2 yr period from June 1968 to December 1980 nineteen different river control structures were instrumented. The general experience to date has been a marked improvement in completeness of record, with the average performance somewhere in the 80 percentile range. Performance percentiles at individual sites have ranged from the mid 90's to about 70. Maintenance records show the instruments to be virtually trouble free, except for the unpredictable acts of nature and man. (Author's abstract)
W89-09069

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09073

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1981 THROUGH OCTOBER 1982,
Geological Survey, Augusta, ME. Water Re-

sources Div.
For primary bibliographic entry see Field 2H.
W89-09074

REPORT OF THE U.S. GEOLOGICAL SURVEY'S ANALYTICAL EVALUATION PROGRAM--STANDARD REFERENCE WATER SAMPLES M-82 (MAJOR CONSTITUENTS), T-83 (TRACE CONSTITUENTS), N-8 (NUTRIENTS), AND P-2 (PRECIPITATION SNOWMELT),
Geological Survey, Denver, CO. Water Resources Div.
V. J. Janzer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-864, 1983. 120p, 14 tab, 3 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Standards, *Data collections, Laboratories, Quality control, Precipitation, Snowmelt, Water quality control.

The U.S. Geological Survey began an interlaboratory testing program of reference water samples in 1962. Principal purposes of the program are to provide a means for participating water laboratories to: (1) identify analytical problem areas; (2) ascertain the accuracy and precision of common water analyses and analytical methods and; (3) provide reference samples for continuing quality assurance testing. Participation in this continuing quality assurance program is mandatory for all domestic laboratories providing water analysis data for Survey use. Analytical data submitted by the participating laboratories that analyzed the respective reference samples distributed in October 1982 are presented. Relative performance ratings achieved by the laboratories for each determination and statistical evaluation of the data are given in 14 tables. (Author's abstract)
W89-09075

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEBRASKA, 1984,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09087

PROCEDURAL GUIDE FOR INTERNATIONAL GAUGING STATIONS ON BOUNDARY WATERS BETWEEN CANADA AND THE UNITED STATES OF AMERICA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-09089

WATER RESOURCES ACTIVITIES IN LOUISIANA DISTRICT FISCAL YEAR 1985,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09094

METHODS FOR DETERMINATION OF INORGANIC SUBSTANCES IN WATER AND FLUVIAL SEDIMENTS.
Geological Survey, Denver, CO. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-495, 1985. Techniques of Water-Resources Investigations, Book 5, Chapter A1. 709p, 53 fig, 16 tab, 45 ref. Edited by M. J. Fishman and L. C. Friedman.

Descriptors: *Chemical analysis, *Pollutant identification, *Inorganic compounds, *Water analysis, *Fluvial sediments, Suspended sediments, Chemical analysis, Bottom sediments, Physical properties, Quality control, Laboratories.

Chapter A1 of Techniques of Water-Resources Investigations, Book 5, contains methods used by the U.S. Geological Survey to analyze samples of water, suspended sediments, and bottom material for their content of inorganic constituents. Included are methods for determining the concentration of dissolved constituents in water, total recoverable and total of constituents in water-suspended sediment samples, and recoverable and total concentrations of constituents in samples of bottom material. Essential definitions are included in the introduction to the manual, along with a brief discussion of the use of significant figures in calculating and reporting analytical results. Quality control in the water analysis laboratory is discussed, including accuracy and precision of analyses, the use of standard reference water samples, and the operation of an effective quality assurance program. Methods for sample preparation and pretreatment are given also. A brief discussion of the principles of the analytical techniques involved and their particular application to water and sediment analysis is presented. The analytical methods involving these techniques are arranged alphabetically according to constituent. For each method given, the general topics covered are application, principle of the method, interferences, apparatus and reagents required, a detailed description of the analytical procedure, reporting results, units and significant figures, and analytical precision data, when available. More than 125 methods are given for the determination of 70 different inorganic constituents and physical properties of water, suspended sediment, and bottom material. (Author's abstract)
W89-09097

OPERATION OF HYDROLOGIC DATA COLLECTION STATIONS BY THE U.S. GEOLOGICAL SURVEY IN 1985,
Geological Survey, Reston, VA. Water Resources Div.
A. Condes de la Torre.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-640, 1985. 37p, 29 fig, 1 tab, 5 ref.

Descriptors: *Water resources data, *Hydrologic data, *Data acquisition, Surface water, Water quality, Groundwater level, Groundwater quality, Precipitation, Economic aspects, Hydrologic budget, Gaging stations, Reservoirs, Lakes.

The U.S. Geological Survey (USGS) operated hydrologic data collection stations during fiscal yr 1985 in response to the needs of all levels of Government for hydrologic information. Surface water discharge was determined at 11,076 stations; stage data on streams, reservoirs, and lakes were recorded at 2,141 stations; and surface water quality was determined at 4,166 stations. Groundwater levels were measured at 39,301 stations, and the quality of groundwater was determined at 9,263 stations nationwide. Data on sediment were collected daily at 212 stations and on a periodic basis at 1,027 stations. Information on precipitation quantity was collected at 921 stations, and the quality of precipitation was analyzed at 108 stations. Data collection platforms for satellite telemetry of hydrologic information were used at 1,520 USGS stations. Funding support for the hydrologic stations was derived either solely or from a combination of three major sources--the Geological Survey's Federal Program appropriation, the Federal-State Cooperative Program, and reimbursements from other Federal agencies. (Author's abstract)
W89-09103

EVAPOTRANSPIRATION ESTIMATES USING REMOTE-SENSING DATA, PARKER AND PALO VERDE VALLEYS, ARIZONA AND CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2D.
W89-09110

PRELIMINARY REPORT ON GEOPHYSICAL WELL-LOGGING ACTIVITY ON THE SALTON SEA SCIENTIFIC DRILLING PROJECT, IMPERIAL VALLEY, CALIFORNIA,
Geological Survey, Denver, CO. Water Resources Div.
F. L. Paillet, R. H. Morin, R. E. Hodges, L. C. Robison, and S. S. Priest.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-544, 1986. 99p, 23 fig, 9 tab, 10 ref. Edited by Frederick L. Paillet.

Descriptors: *Hydraulic structures, *Wells, *Borehole geophysics, *California, *Geophysics, *Logging (Recording), *Drilling, *Hydrothermal studies, Drillers logs, Groundwater, Data acquisition, Boreholes, Measuring instruments, Temperature effects.

The Salton Sea Scientific Drilling Project has culminated in a 10,564-ft deep test well, State 2-14 well, in the Imperial Valley of southern California. A comprehensive scientific program of drilling, coring, and downhole measurements, which was conducted for about 5 months, has obtained much scientific information concerning the physical and chemical processes associated with an active hydrothermal system. This report primarily focuses on the geophysical logging activities at the State 2-14 well and provides early dissemination of geophysical data to other investigators working on complementary studies. Geophysical-log data were obtained by a commercial logging company and by the U.S. Geological Survey (USGS). Most of the commercial logs were obtained during three visits to the site; only one commercial log was obtained below a depth of 6,000 ft. The commercial logs obtained were dual induction, natural gamma, compensated neutron formation density, caliper and sonic. The USGS logging effort consisted of four primary periods, with many logs extending below a depth of 6,000 ft. The USGS logs obtained were temperature, caliper, natural gamma, gamma spectral, epithermal neutron, acoustic velocity, full-waveform, and acoustic televiewer. Various problems occurred throughout the drilling phase of the Salton Sea Scientific Drilling Project that made successful logging difficult: (1) borehole constrictions, possibly resulting from mud coagulation, (2) maximum temperatures of about 300 C, and (3) borehole conditions unfavorable for logging because of numerous zones of fluid loss, cement plugs, and damage caused by repeated trips in and out of the hole. These factors hampered and compromised logging quality at several open-hole intervals. The quality of the logs was dependent on the degree of probe sophistication and sensitivity to borehole-wall conditions. Digitized logs presented were processed on site and are presented in increments of 1,000 ft. A summary of the numerous factors that may be relevant to this interpretation also is presented. (Lantz-PTT)
W89-09114

DOCUMENTATION OF A DEEP PERCOLATION MODEL FOR ESTIMATING GROUNDWATER RECHARGE,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09117

IMPROVEMENT OF FILAMENT-PROTECTION CIRCUITRY IN A FINNIGAN MODEL 251 MASS SPECTROMETER,
Geological Survey, Reston, VA. Water Resources Div.
J. D. Wildman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-484, (1986). 4p, 1 ref.

Descriptors: *Measuring instruments, *Mass spectrometry, Maintenance, Performance evaluation, Electronic equipment.

As delivered from Finnigan MAT, the emission current of the Leybold-Heraeus model IM210 ionization vacuum gage on a model 251 isotope ratio mass spectrometer can turn on as soon as the 'PUMP ON' switch is depressed, before a good vacuum in the mass spectrometer is attained. The filament in the source of the mass spectrometer

may turn on at the same time, thereby shortening its life or burning it out if the vacuum is poor. This design flaw can be corrected by a simple modification of the electronic circuitry. (Author's abstract)
W89-09123

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1985 THROUGH SEPTEMBER 1986,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09132

ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WATER-RESOURCES DIVISION IN NORTH CAROLINA, 1986,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09136

WATER RESOURCES ACTIVITIES IN FLORIDA, 1985-86.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09140

FRACTURE CHARACTERIZATION AND FRACTURE-PERMEABILITY ESTIMATION AT THE UNDERGROUND RESEARCH LABORATORY IN SOUTHEASTERN MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W89-09144

SUMMARY OF THE U.S. GEOLOGICAL SURVEY NATIONAL WATER-QUALITY ASSESSMENT PROGRAM,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09203

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1987,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W89-09205

ACTIVITIES OF THE WATER RESOURCES DIVISION, CALIFORNIA DISTRICT, IN THE 1987 FISCAL YEAR,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09206

BASE OF MODERATELY SALINE GROUND WATER IN THE UINTA BASIN, UTAH, WITH AN INTRODUCTORY SECTION DESCRIBING THE METHODS USED IN DETERMINING ITS POSITION,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09229

MICROCOMPUTER-BASED VERSION OF SIPT--A PROGRAM FOR THE INTERPRETATION OF SEISMIC-REFRACTION DATA (TEXT),
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09233

WATER-QUALITY ASSESSMENT OF THE CARSON RIVER GROUND-WATER BASIN, NEVADA AND CALIFORNIA: PROJECT DESCRIPTION,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09234

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1985 AND 1986,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09247

DETERMINATION OF STREAM REAERATION COEFFICIENTS BY USE OF TRACERS,
Geological Survey, Reston, VA. Water Resources Div.
F. A. Kilpatrick, R. E. Rathbun, N. Yotsukura, G. W. Parker, and L. L. DeLong.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-245, (1987). 84p, 31 fig, 13 tab, 33 ref.

Descriptors: *Reaeration coefficent, *Data acquisition, *Aeration, *Tracers, *Streams, Oxygenation, Radioactive tracers, Hydrocarbons, Injection.

Stream reaeration is the physical absorption of oxygen from the atmosphere by a flowing stream. This is the primary process by which a stream replenishes the oxygen consumed in the biodegradation of organic wastes. Prior to 1965, reaeration rate coefficients could be estimated only by indirect methods. In 1965, a direct method of measuring stream reaeration coefficients was developed in which a radioactive tracer gas was injected into a stream--the tracer gas being desorbed from the stream inversely to how oxygen would be absorbed. The technique has since been modified by substituting hydrocarbon gases for the radioactive tracer gas. The slug-injection and constant-rate injection methods of performing gas tracer desorption measurements are described. Emphasis is on the use of rhodamine WT dye as a relatively conservative tracer and propane as the nonconservative gas tracer, on planning field tests, methods of injection, sampling and analysis, and computational techniques to compute desorption and reaeration coefficients. (Author's abstract)
W89-09249

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA--FISCAL YEARS 1986-87,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09253

INDEX OF SURFACE-WATER STATIONS IN TEXAS, JANUARY 1987.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09265

7C. Evaluation, Processing and Publication

STATISTICAL ANALYSIS OF WATER QUALITY DATA AFFECTED BY LIMITS OF DETECTION,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
P. S. Porter.
Available from University Microfilms International, 300 N. Zeeb Road, Ann Arbor, MI 48106, Order No. 8705478. Ph.D. Dissertation, 1986. 53 fig, 11 tab, 113 ref, 3 append.

Descriptors: *Monitoring, *Statistical analysis, *Detection limits, *Water quality, *Data processing, Statistical methods, Error analysis, Model studies.

The effect of measurement error on the statistical structure of water quality data is illustrated using a model for measurement error that is appropriate for low analyte concentrations. The model was developed from theorectical studies on random signal error in chemical analysis. The concept of monitoring sensitivity is proposed as a means of characterizing the ability of a monitoring system to detect change. Estimation of the mean of a water quality population and the description of a confidence interval for the mean are the primary examples used. Also for simplification, water quality random variables are considered to be distributed log normally, and observations are considered to be independent. Findings indicate that the presumptions in censoring that nothing is known about results below the censoring level (usually the LOD or limit of detection) and that all results above the LOD are reliable do not hold true for water quality data. Information from water quality analyses are random variables; therefore, it is usually unsound, from a data analysis perspective, to regard them as constant. Observation error can significantly alter the statistical properties of a water quality random variable. Data with significant observation error will have statistical properties characteristic of the error. (Cremmins-AEPCO)
W89-08264

SUMMARY OF WATER DATA FOR THE JANZEN RECHARGE INVESTIGATION, SCOTT COUNTY, KANSAS, 1980-86,
Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Stulken.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open-File Report 88-83, 1988. 38p, 6 fig, 12 tab, 2 ref.

Descriptors: *Groundwater level, *Artificial recharge, Groundwater recharge, Recharge ponds, Pit recharge, Replenishment, Hydrologic data.

The U.S. Geological Survey, in cooperation with the Western Kansas Groundwater Management District No. 1, established data collection instrumentation around an earthen dam in Scott County, west-central Kansas. The dam was placed on an ephemeral drainage to monitor water storage behind the dam, precipitation, and groundwater levels in the vicinity. This report briefly describes the site and summarizes the data collected at that site from May 1980 through September 1986, when data collection was discontinued. The dam is capable of impounding 300-acre-ft of water at the level of the emergency spillway, draining to 24 acre-ft of water at the level of the principal spillway. The reservoir behind the dam receives surface water runoff from a drainage area of about 8,000 acres. Water storage behind the dam occurred three times during the period of data collection, but water never reached the level of the principal spillway. (USGS)
W89-08305

ANALYSES OF WATER RESOURCES OF THE BIG SIOUX AQUIFER, MOODY COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08306

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1988,
Geological Survey, Houston, TX. Water Resources Div.
R. K. Gabrysch, C. E. Ranzau, and L. S. Coplin.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open File Report 88-334, 1988. 2p, 2 fig, 1 ref.

Descriptors: *Maps, *Water level, *Water level fluctuations, *Groundwater level, *Water re-

sources data, *Texas, Houston, Evangeline Aquifer, Chicot Aquifer.

Two maps show water levels in wells in the Houston, Texas, area in the Chicot aquifer and the Evangeline aquifer, spring 1988. Both the Chicot and the Evangeline aquifers are composed of several sand layers with different potentiometric surfaces. These maps, however, show approximations of single potentiometric surfaces that represent composite hydraulic heads. (USGS)
W89-08307

WATER QUALITY DATA FROM THE OBSERVATION WELL NETWORK IN ILLINOIS, 1985-87,
Geological Survey, Urbana, IL. Water Resources Div.
D. C. Voelker, D. J. Oberg, and M. J. Grober.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open-File Report 87-538, 1988. 729p, 2 fig, 8 tab, 6 ref.

Descriptors: *Data collections, *Groundwater, *Water quality, *Illinois, *Hydrologic data, Water resources data.

Water quality and well-site information are presented for public water supply wells in Illinois. These wells were sampled during the period January 1985 through June 1987 as part of an ongoing cooperative groundwater observation network in the State. Water quality data are tabulated for physical parameters, nutrients, common constituents, metals, phenols, cyanide, and volatile organic compounds. A subnetwork of wells also have data on several pesticides and herbicides. Some well-site information is also presented in this report. (USGS)
W89-08308

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1988,
Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open File Map Report 88-460, 1988. 1 sheet.

Descriptors: *Hydrologic data, *Groundwater level, *Maps, *Florida, *Floridan Aquifer, *Potentiometric surface, Water level, St. Johns River Water Management District.

This map shows the potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, for May 1988. The Upper Floridan aquifer is the principal source of potable water in the area. Water level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area of Nassau County, a 30-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 127 ft above sea level in Polk County to 79 ft below sea level in Nassau County. Water levels in many key wells were about the May average. Most levels in the district were below the levels of May 1987. Declines of about a foot or less from May 1987 levels were common along the coast, but inland, the potentiometric surface declined as much as 2 to 6 ft in places. (USGS)
W89-08309

LOCATION MAPS AND LIST OF U.S. GEOLOGICAL SURVEY REPORTS ON WATER RESOURCES IN ALASKA, 1950 TO 1988.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-08314

WATER RESOURCES ACTIVITIES IN NEW YORK, 1987-88,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-08322

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--ADIRONDACK SHEET,
Geological Survey, Albany, NY. Water Resources Div.
E. F. Bugliosi, and R. A. Trudell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 87-4276, 1988. 1 sheet, 1 ill, 8 ref.

Descriptors: *Groundwater, *Well yield, *Geohydrology, *Maps, *New York, Aquifers, Hydrology, Adirondacks, Hydrologic data, Data collections.

This map shows the location and potential well yield from unconsolidated aquifers in the Adirondack region at a 1:250,000 scale. It also delineates segments of aquifers that are heavily used by community water systems and designated by the New York State Department of Environmental Conservation as 'Primary Water Supply' aquifers and cites published reports that give detailed information on each area. Most aquifers were deposited in low-lying areas such as valleys or plains during deglaciation of the region. Thick, permeable, well-sorted sand and gravel deposits generally yield large quantities of water, greater than 100 gal/min. Thin sand, sand and gravel deposits, or thicker gravel units have a large content of silt and fine sand, yield moderate amounts of water, 10 to 100 gal/min. Wells dug in till and those drilled in bedrock commonly yield less than 10 gal/min. (USGS)
W89-08323

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--LOWER HUDSON SHEET,
Geological Survey, Albany, NY. Water Resources Div.
E. F. Bugliosi, and R. A. Trudell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 87-4274, 1988. 1 sheet, 1 ill, 11 ref.

Descriptors: *Groundwater, *Well yield, *Geohydrology, *Maps, *New York, Aquifers, Hydrology, Hudson Valley, Hydrologic data, Data collections.

This map shows the location and potential well yields from unconsolidated aquifers in the lower-Hudson region at a 1:250,000 scale. It also delineates segments of aquifers that are heavily used by community water systems and designated by the New York State Department of Environmental Conservation as 'Primary water supply' aquifers and cites published reports that give detailed information on each area. Most aquifers were deposited in low-lying areas such as valleys or plains during deglaciation of the region. Thick, permeable, well-sorted sand and gravel deposits generally yield large quantities of water, more than 100 gal/min. Thin sand, sand and gravel deposits, or thicker gravel units that have a large content of silt and fine sand, yield moderate amounts of water, 10 to 100 gal/min. Wells dug in till and those drilled in bedrock commonly yield less than 10 gal/min. (USGS)
W89-08324

POTENTIAL YIELD OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--HUDSON-MOHAWK SHEET,
Geological Survey, Albany, NY. Water Resources Div.
E. F. Bugliosi, R. A. Trudell, and G. D. Casey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 87-4275, 1988. 1 sheet, 1 ill, 14 ref.

Descriptors: *Groundwater, *Geohydrology, *Maps, *New York, *Well yield, Aquifers, Hydrology, Hydrologic data, Data collections.

This map shows the location and potential well yields of unconsolidated aquifers in the Hudson-Mohawk region at a scale of 1:250,000. It also delineates segments of aquifers that are heavily used by community water systems and designated by the New York State Department of Environmental Conservation as 'Primary Water Supply' aquifers, and cites published reports that give detailed information on each area. Most aquifers were deposited in low-lying areas such as valleys or plains during deglaciations of the region. Thick, permeable, well-sorted sand and gravel deposits generally yield large quantities of water, greater than 100 gal/min. Thin sand, sand and gravel deposits, or thicker gravel units that have a large content of silt and fine sand, yield moderate amounts of water, 10 to 100 gal/min. Wells dug in till and those drilled in bedrock commonly yield less than 10 gal/min. (USGS)
W89-08325

POTENTIAL YIELDS OF WELLS IN UNCONSOLIDATED AQUIFERS IN UPSTATE NEW YORK--NIAGARA SHEET,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resources Investigations Report 88-4076, 1988. 1 sheet, 6 ref.

Descriptors: *Groundwater, *Unconsolidated aquifers, *Well yield, *Geohydrology, *Maps, *New York, Geohydrologic boundaries, Data collections, Hydrologic data.

This map depicts the locations and potential well yields of unconsolidated aquifers in western New York at a scale of 1:250,000. It also delineates segments of aquifers that are used for public water supplies and designated by the New York State Department of Environmental Conservation as 'Primary Water Supply Aquifers.' The map also lists published reports that give detailed information on each area. Most aquifers were deposited in low areas, such as valleys and plains, during deglaciation of the region. Thick, permeable, well-sorted sand and gravel units yield large quantities of water - more than 100 gal/min - to properly constructed wells. Thin sand units and sand and gravel units and thicker gravel units that have a large content of silt and fine sand yield moderate amounts of water, 10 to 100 gal/min. Dug wells that tap till or lacustrine deposits yield less than 5 gal/min. Well yields from bedrock are not indicated. (USGS)
W89-08326

GROUNDWATER AVAILABILITY IN THE CENTRAL PART OF LAKE ONTARIO BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller, and M. M. Krebs.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Water-Resource Investigations Report 87-4183, 1988. 3 sheets, 9 ref.

Descriptors: *Geohydrology, *New York, *Maps, *Unconsolidated aquifers, *Groundwater, Surficial geology, Wells, Geohydrologic boundaries, Data collections, Hydrologic data.

A set of three maps showing surficial geology, distribution of glacial aquifers, and potential well yield in the 708 sq mi central part of the Lake Ontario basin are presented at a scale of 1:125,000. The basin is parallel to Lake Ontario and extends from Rochester in the west to Oswego in the east. Aquifers consisting primarily of sand and gravel formed where meltwaters from glaciers deposited kame and outwash sand and gravel and where wave action along shores of glacial lakes eroded, reworked, and deposited beaches. Thick deposits

of well-sorted sand and gravel yield relatively large quantities of water - typically more than 100 gal/min. Aquifers consisting of thin beds of sand and (or) gravel or thick gravel that contain a large proportion of silt and fine sand yield moderate amounts of water, 10 to 100 gal/min. Dug and driven wells that tap fine to medium sand deposits typically yield 1 to 10 gal/min. (USGS)
W89-08327

MEAN ANNUAL PRECIPITATION MAP FOR IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. Molnau, and F. M. Winters.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115539/AS, price codes: A03 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, July 1988. 39p, 2 tab, 17 ref. USGS contract 14-08-0001-G1429. USGS project G1419-03.

Descriptors: *Precipitation, *Idaho, *Data collections, *Annual precipitation, Interpolation, Precipitation mapping techniques.

Sound estimates of the amounts and distributions of mean annual precipitation in Idaho have become increasingly important in recent years because of stringent design requirements and increasingly tighter supplies of water. The current mean annual precipitation (MAP) map of Idaho was prepared in 1965. Since then, more data have been collected, particularly in the higher elevation zones where the previous map had to rely on models to provide estimates. The Soil Conservation Service's SNOTEL system provides data for these very important high elevation zones where the majority of Idaho's water originates. Lower elevation data are obtained primarily from the National Weather Service Cooperative network. Monthly data were compiled for the base period of 1961 to 1985. Missing data were estimated by using an average system surrounding stations. All of these data were then plotted using a contouring package. No manual smoothing was done as the primary objective was to prove out the mapping technique. For the next phase of the project, various interpolation techniques will be used as well as regression models in areas of sparse or uncertain data. The coefficient of variation of the annual precipitation was also plotted. This resulted in a very smooth contour suggesting that lines of equal Cv could be overlayed upon the (MAP) map giving users an idea of the variation in precipitation as well as the mean value. (USGS)
W89-08343

WATER SUPPLY AND DEMAND FOR NEW MEXICO 1985-2030 - RESOURCE DATA BASE,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 6D.
W89-08347

USER'S GUIDE FOR RIV2 - A PACKAGE FOR ROUTING AND ACCOUNTING OF RIVER DISCHARGE FOR A MODULAR, THREE-DIMENSIONAL, FINITE-DIFFERENCE, GROUNDWATER FLOW MODEL,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08354

U.S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1985-86,
Geological Survey, Rapid City, SD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08360

HYDROLOGIC DATA COLLECTION ACTIVITIES IN THE SOLOMON GULCH BASIN NEAR VALDEZ, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
B. B. Bigelow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-719, 1988. 15p, 9 fig, 4 tab.

Descriptors: *Dam effects, *Streamflow, *Discharge measurement, *Alaska, Powerplants, Penstocks, Diversion structures, Fish hatcheries, Flow characteristics, Stream discharge, Valdez.

In 1981, the Alaska Power Authority completed construction of a dam spillway at the north end of Solomon Lake near Valdez. Regulation and diversion from the dam since 1982 have significantly altered the natural flow characteristics of Solomon Gulch. In September 1986, the Geological Survey began data collection to determine mean daily discharge at four sites below Solomon Lake and thus document the effects of regulation and diversion of water on the flow at various points in the system. Periodic discharge measurements and continuous records of water stage were obtained at two of the sites, and daily discharge values were computed for all four sites. The report contains descriptions of the data collection sites and the discharge records for each site for September 1986 and water year 1987. (USGS)
W89-08362

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO -- FISCAL YEAR 1988,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-08374

DIRECT-CURRENT RESISTIVITY DATA FROM 94 SITES IN NORTHEASTERN PALM BEACH COUNTY, FLORIDA,
Geological Survey, Reston, VA. Water Resources Div.
C. J. Peterson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-464, (1988). 112p, 2 fig, 13 ref.

Descriptors: *Resistivity, *Electrical studies, *Florida, Geophysics, Palm Beach County.

Direct-current resistivity data were collected from 94 vertical electric sounding profiles in northeastern Palm Beach County, Florida. Direct-current resistivity data, which may be used to determine the location and thicknesses of shallow, semipermeable marls or locate zones of high chloride concentration, are presented in this report. The resistivity data consist of field data, smoothed data, layer resistivity from smoothed data, and Cartesian graphs of resistivity in relation to depth for 94 sites located in northeastern Palm Beach County. (USGS)
W89-08375

WATER LEVELS IN PERIODICALLY MEASURED WELLS IN THE YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA, 1981-87,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08378

HYDROLOGIC DATA FOR INDIAN CREEK BASIN, FAYETTE AND WESTMORELAND COUNTIES, PENNSYLVANIA, 1985-87,
Geological Survey, Pittsburgh, PA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-08379

CHEMICAL AND HYDROLOGIC DATA FOR SELECTED THERMAL-WATER WELLS AND NONTHERMAL SPRINGS IN THE BOISE AREA, SOUTHWESTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08383

INDEX OF SURFACE WATER STATIONS IN TEXAS, JANUARY 1988,
Geological Survey, Austin, TX. Water Resources Div.
J. Rawson, E. R. Carrillo, and H. D. Buckner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-483, (1988). 19p, 2 fig, 1 tab.

Descriptors: *Index of Surface Water Stations, Water resources, Texas District.

As of January 1, 1988, the surface water data collection network in Texas included 368 continuous streamflow, 72 continuous or daily reservoir-contents, 38 gage height only, 15 crest stage partial record, 4 periodic discharge through range, 32 flood-hydrograph partial-record, 9 flood-profile partial-record, 36 low-flow partial record, 45 daily chemical-quality, 19 lake surveys, 160 periodic organic and (or) nutrient, 3 periodic insecticide, 33 periodic pesticide, 20 automatic sampler, 137 periodic minor elements, 125 periodic chemical-quality, 74 periodic physical-organic, 24 continuous-recording three- or four-parameter water quality, 34 periodic sediment, 21 continuous-recording temperature, and 30 national stream-quality accounting network stations. Plate 1 shows the location of surface water streamflow or reservoir content and chemical quality or sediment stations in Texas. Plate 2 shows the location of partial-record surface-water stations. (USGS)
W89-08384

WATER QUALITY IN REEDY FORK AND BUFFALO CREEK BASINS IN THE GREENSBORO AREA, NORTH CAROLINA, 1986-87,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08387

WATER QUALITY DATA, SAN JOAQUIN VALLEY, CALIFORNIA, MARCH 1985 TO MARCH 1987,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08388

U. S. GEOLOGICAL SURVEY APPLIED RESEARCH STUDIES OF THE CHEYENNE RIVER SYSTEM, SOUTH DAKOTA: DESCRIPTION AND COLLATION OF DATA, WATER YEARS 1985-86,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08390

COMPILATION OF GROUNDWATER LEVEL MEASUREMENTS OBTAINED BY THE UNITED STATES GEOLOGICAL SURVEY IN PUERTO RICO, 1958-1985,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08391

HYDROGEOCHEMICAL DATA FROM AN ACIDIC DEPOSITION STUDY AT MCDONALDS BRANCH BASIN IN THE NEW JERSEY PINELANDS, 1983-86,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08392

HYDROLOGIC DATA FOR THE SALT BAYOU ESTUARY NEAR SABINE PASS, TEXAS, OCTOBER 1984 TO MARCH 1986,

Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 2L.
W89-08393

EXTENSION OF STREAMFLOW AND DISSOLVED-SOLIDS RECORDS AT SELECTED SITES IN THE COLORADO RIVER BASIN, ARIZONA, CALIFORNIA, COLORADO, NEVADA, NEW MEXICO, UTAH, AND WYOMING, 1940-85,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08398

ESTIMATION OF NATURAL DISSOLVED-SOLIDS DISCHARGE IN THE UPPER COLORADO RIVER BASIN, WESTERN UNITED STATES,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-08399

EVALUATION OF THE FLOOD HYDROLOGY IN THE COLORADO FRONT RANGE USING PRECIPITATION, STREAMFLOW, AND PALEOFLOOD DATA FOR THE BIG THOMPSON RIVER BASIN,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08406

GEOHYDROLOGY, WATER QUALITY AND PRELIMINARY SIMULATIONS OF GROUNDWATER FLOW OF THE ALLUVIAL AQUIFER IN THE UPPER BLACK SQUIRREL CREEK BASIN, EL PASO COUNTY, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08408

MAP OF BEDROCK-SURFACE TOPOGRAPHY IN PARTS OF THE PATERSON AND POMPTON PLAINS QUADRANGLES, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
P. Lacombe, and P. B. Duran.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4061, 1988. 1 sheet, 3 fig, 7 ref.

Descriptors: *Bedrock, *Seismic properties, *New Jersey, *Mapping, *Geologic mapping, Tunnels, Engineering geology, Maps, Newark basin.

A seismic-refraction survey was done by the U.S. Geological Survey, in cooperation with the U.S. Army Corps of Engineers (ACOE), to define the altitudes of the bedrock surface beneath part of a proposed water diversion tunnel to control periodic heavy flooding along parts of the Passaic and Pompton Rivers in northeastern New Jersey. The altitude of the top of the tunnel is planned to be approximately at sea level. The ACOE would like to have a minimum of 40 ft of bedrock above the top of the tunnel for construction and engineering purposes. The results of the study show that the bedrock ranges in altitude from 40 to 140 ft above sea level, and that there is a northeast trending bedrock valley that overlies the proposed tunnel alignment. (USGS)
W89-08419

ESTIMATED THICKNESS AND POTENTIAL WELL YIELD OF STRATIFIED-DRIFT DEPOSITS IN THE UPPER CROTON RIVER BASIN, WESTCHESTER COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08430

SUBSURFACE GEOLOGY OF PALEOZOIC, MESOZOIC, AND CENOZOIC UNITS IN SOUTHEAST MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
T. O. Mesko.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Miscellaneous Investigations Series Map I-1875, 1988. 2 sheets, 29 ref.

Descriptors: *Geohydrology, *Water quality, *Potentiometric surface, *Waste level declines, *Groundwater, *Maps, Aquifers.

Three major unconsolidated aquifer systems underlie southeast Missouri. The Mississippi River Valley Alluvial aquifer is the surficial unit extensively used for irrigation, public and domestic supplies. This aquifer can yield over 3,000 gal/min to wells. No significant, long-term water level declines have occurred. Water generally is fresh with dissolved-solids concentrations ranging from less than 150 to about 500 mg/L. Several zones of large specific conductance values have been mapped. The Wilcox and Claiborne aquifer system underlies the alluvial aquifer. The few wells completed in this system primarily are used for public supplies. Wells in these aquifers can yield 1,500 gal/min. No regional water level declines have been noted; however, localized declines have been observed near areas where the aquifer is heavily pumped for public supplies. Dissolved solids concentration ranges from 100 to 175 mg/L and water generally is fresh. The upper Cretaceous (McNairy) aquifer is the basal unconsolidated aquifer extensively used for public supplies. Wells completed in this aquifer are flowing artesian with water levels 30 ft above land surface and free flowing yields of hundreds of gal/min. A water level decline of 30 ft was noted at one site and a seasonal fluctuation of greater than 10 ft at another. Dissolved-solids concentration ranged from 150 to more than 2,200 mg/L; however, no significant long term changes have occurred. (USGS)
W89-08452

GEOHYDROLOGIC FRAMEWORK OF THE GULF COASTAL PLAIN,
Geological Survey, Austin, TX. Water Resources Div.
R. L. Hosman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Hydrologic Investigations Atlas HA-695, 1988. 2 sheets (maps), 4 fig, 2 tab, 25 ref.

Descriptors: *Geohydrology, *Aquifers, *Maps, *Geohydrologic units, *Gulf Coastal Plain, Geologic units, Water table, Geohydrologic framework, Cenozoic stratigraphy, Geologic mapping, Mississippi embayment, Alabama, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, Texas.

The Gulf Coast Regional Aquifer-Systems Analysis covers approximately 290,000 sq mi in Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, and Texas, including the continental shelf along coastal states. The area to be studied encompasses most of the Gulf Coastal Plain (which includes the Mississippi embayment) from the Rio Grande on the west to the western tip of Florida on the east. The inland boundary of the study area is the updip limit of the occurrence of Cenozoic rocks, except in the northeastern part where the uppermost water bearing Cretaceous unit is included. The gulfward boundary is the outer edge of the continental shelf. The overall objective of the study is the investigation of the major Cenozoic aquifer systems, and this report describes the generalized geohydrologic framework within which these aquifer systems occur. A fence diagram and a geologic map pictorially present the distribution and stratigraphic relations of the major geologic units, and a regional correlation chart shows the equivalency of the units as they are recognized in the various states. A generalized description of the physical and hydrologic properties of the geologic units is given in tabular form as support for a brief text. Major tectonic features are shown on a regional structure map, and another map shows the regional water table as it is estimated to have appeared prior to development. (USGS)
W89-08453

COMPUTER PROGRAM INCORPORATING PITZER'S EQUATIONS FOR CALCULATION OF GEOCHEMICAL REACTIONS IN BRINES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-08459

STATISTICAL SUMMARY OF SELECTED WATER QUALITY DATA (WATER YEARS 1975 THROUGH 1985) FOR ARKANSAS RIVERS AND STREAMS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08461

HYDROLOGY OF THE CITRUS PARK QUADRANGLE, HILLSBOROUGH COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
M. A. Corral, and T. H. Thompson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 87-4166, 1988. 13p, 1 map (sheet), 20 fig, 36 ref. Project FL-429.

Descriptors: *Hydrology, *Groundwater, *Potentiometric level, *Florida, Maps, Surface water, Well fields, Recharge, Water quality, Citrus Park quadrangle, Hillsborough County, Maps.

Rapid increases in population and development in the Citrus Park quadrangle northwest of Tampa have increased the demand for water from the surficial and Upper Floridan aquifers, while at the same time decreasing the amount of wetlands and agricultural or forested lands that formerly provided recharge to these aquifers. Because the study area is underlain by soluble deposits, sinkholes and small closed depressions are common surface features. Some of the lakes in the area are remnants of ancient sinkholes. Four streams drain the area. Two of the streams have been channelized to reduce the risk of local flooding. Pumping from three municipal well fields within the study area and from three nearby well fields has lowered the potentiometric surface of the Upper Floridan aquifer. The pumping also lowers the water table levels by inducing recharge from the surficial aquifer to the Upper Floridan aquifer. Heavy pumpage may prompt sinkhole activity, or in areas near the coast, induce saltwater intrusion. Water quality of streams and groundwater is generally good except in the vicinity of landfills and where saltwater encroachment into the principal water bearing unit has occurred along the coast. (USGS)
W89-08464

PRACTICAL HANDBOOK OF ENVIRONMENTAL CONTROL.
For primary bibliographic entry see Field 5G.
W89-08469

INSTITUTE OF HYDROLOGY DISTRIBUTED MODEL,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W89-08483

WESTERN LAKE SURVEY, PHASE I. CHARACTERISTICS OF LAKES IN THE WESTERN UNITED STATES: VOLUME II. DATA COMPENDIUM FOR SELECTED PHYSICAL AND CHEMICAL VARIABLES,
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
For primary bibliographic entry see Field 5B.

W89-08500

FISHERIES-OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI) SURFACE METEOROLOGICAL OBSERVATIONS AT CHERNI ISLAND AND UGAIUSHAK ISLAND-FISCAL YEAR 1986,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2B.
W89-08501

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 2. DESIGN OF THE EMISSION INVENTORY: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
For primary bibliographic entry see Field 5B.
W89-08508

ACID DEPOSITION RESEARCH PROGRAM. VOLUME 4, RESULTS OF THE EMISSION SOURCE SURVEYS: EMISSION INVENTORY OF SULPHUR OXIDES AND NITROGEN OXIDES IN ALBERTA,
Acid Deposition Research Program, Calgary (Alberta).
For primary bibliographic entry see Field 5B.
W89-08510

CORRELATION PROPERTIES OF RAINFALL RATES IN U.K.,
Bradford Univ. (England). Postgraduate School of Electrical and Electronic Engineering.
For primary bibliographic entry see Field 2B.
W89-08516

SOUTH BISCAYNE BAY WATER QUALITY: A TWELVE YEAR RECORD FOR BISCAYNE NATIONAL PARK,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-08519

IN SITU BIOLOGICAL TREATMENT TEST AT KELLY AIR FORCE BASE, VOLUME II: FIELD TEST RESULTS AND COST MODEL,
Science Applications, Inc., McLean, VA.
For primary bibliographic entry see Field 5G.
W89-08538

CANAL DISCHARGE IMPACTS ON BISCAYNE BAY SALINITIES, BISCAYNE NATIONAL PARK,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 2L.
W89-08540

ENDOW: AN APPLICATION OF AN EXPERT SYSTEM IN TECHNOLOGY TRANSFER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6A.
W89-08542

THEMATIC MAPPING FROM AERIAL PHOTOGRAPHS FOR KANDI WATERSHED AND AREA DEVELOPMENT PROJECT, PUNJAB, INDIA,
Planning & Design St.Directorate (IB), Punjab, Chandigarh, India.
B. D. Singh, and K. Singh.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 595-598, 1 fig, 2 ref.

Descriptors: *Watershed management, *Aerial photography, *Mapping, *Regional development, *India, Irrigation, Groundwater, Water quality, Thematic mapping, Data processing, Geomorphology, Hydrology, Geology, Hydrogeology, Kandi tract, Kandi Watershed & Area Development Project.

The use of photo-interpretation techniques for thematic mapping for geomorphological, hydrological, geological, hydrogeological, soil systems and forestry studies of the Kandi Area for the World Bank aided Kandi Watershed & Area Development Project is described. The purpose of the project is to eventually improve and develop about 1,500,000 hectares of the Kandi tract in the State of Punjab. A base map was prepared for each watershed from aerial photographs of 1:50,000 scale and ground based data. The finished maps included: sub-surface lithology and the location of deep tubewells; water level elevation contour and depth to water contour; groundwater quality; present land use; land capability and soil classification; problem soils; layout of dam based irrigation scheme; layout of groundwater based irrigation scheme; and flood plain and flood protection measures. (See also W89-08577) (White-Reimer-PTT)
W89-08578

PHOTO-INTERPRETATION OF LANDFORMS AND THE HYDROGEOLOGIC BEARING IN HIGHLY DEFORMED AREAS, NW OF THE GULF OF SUEZ, EGYPT,
Qatar Univ., Doha.
E. A. Korany, and L. L. Iskandar.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 625-630, 1 tab, 5 fig, 14 ref.

Descriptors: *Aquifers, *Groundwater, *Aerial photography, *Geohydrology, *Gulf of Suez, *Egypt, Data processing, Data interpretation, Photo-mosaics, Stereoscopic analysis, Surface water, Drainage patterns, Geologic fractures.

An image interpretation of landforms was performed on the basis of qualitative and quantitative studies of relief criteria, the drainage network, and the hydrographic features using stereoscopic examination of aerial photographs, the study of photomosaics and landsat imageries, and field checks and measurements. Attention was focused primarily on the hydrogeologic bearings, the control of surface and subsurface water flow, and the impact of groundwater conditions on the Miocene aquifer. The results showed that the area consists of nine drainage sub-basins originating from the high western plateau with the fault planes and fractures controlling the drainage patterns along the pediment and coastal plains. The occasional heavy rain showers in the winter contribute to the groundwater in the Rudeis aquifer which is the main groundwater source in the area. The structural deformation of the area plays a paramount role in the development of landforms and their hydrogeologic bearings which results in the drainage patterns that lead to the specific hydrogeologic characteristics. (See also W89-08577) (White-Reimer-PTT)
W89-08580

SMALL SCALE EROSION HAZARD MAPPING USING LANDSAT INFORMATION IN THE NORTHWEST OF ARGENTINA,
J. M. Sayago.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 669-674, 1 tab, 7 fig, 11 ref.

Descriptors: *Remote sensing, *Aerial photography, *Satellite technology, *Erosion, Data processing, Data interpretation, Mapping, Landsat, Land use, Geomorphology, Argentina, Field tests.

A methodology for small scale mapping of erosion hazard is described using a survey carried out in an extensive region of the Argentine northwest characterized by climatic conditions that fluctuate from semi arid to wet sub-tropical. Through the interpretation of multi-temporal landsat images and conventional aerial photo-interpretation, landform and land use patterns were determined. Field measurements of the Universal Soil Loss Equation factors-rainfall erosivity, soil erodibility, slope steepness and length, and coverage resulted in erosion hazard estimates expressed as the potential rate of soil loss. It was concluded that the area has a high erosion risk due to the increasing population pressure on large areas which are currently covered by natural vegetation. Using a geomorphological basis gives small scale mapping scientific objectivity and is rapid and economical. The visual and/or digital interpretation of Landsat information gives planimetric reliability and multi-temporal information on the landscape dynamics. (See also W89-08577) (White-Reimer-PTT)
W89-08583

METHODOLOGY FOR INTEGRATING SATELLITE IMAGERY AND FIELD OBSERVATIONS FOR HYDROLOGICAL REGIONALISATION IN ALPINE CATCHMENTS,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
R. Allewijn.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 693-697, 6 fig, 20 ref.

Descriptors: *Data acquisition, *Satellite technology, *Remote sensing, *Geohydrology, *Dolomites, Alps, Regional analysis, Regional planning, Catchment areas, Model studies, Watersheds, Watershed management, Field tests, Landsat images.

Years of intensive fieldwork in the N-Italian Dolomites have demonstrated that in complex Alpine environments predictions of stream runoff and sediment yield for ungauged watersheds require a semi-distributed, physically-based regionalization model. The physically-based character of the model has to be guaranteed by detailed field observations, while Landsat remote sensing data can be quite valuable in quantifying the distributed nature of the model. The hierarchical regionalization procedure presently used for this area includes: (1) The delineation of a broad physiographic zone of Permo-Triassic-Liassic rocks with Landsat MSS images; (2) Identification of vegetation and landuse units by a supervised digital classification of Landsat data; (3) Identification of surface water systems and related groundwater flow systems by comparing field survey data with analyzed Landsat data; (4) Storage of the spatial characteristics of the hydrological units in a Geographic Information System which serves as a data bank for semi-distributed water and sediment yield models; and (5) Use of Landsat data to correlate reflectance indices with specific field-data-based model parameters. This procedure is being developed for a reference area and will be tested for a control area during a later stage of the investigation. (See also W89-08577) (Author's abstract)
W89-08584

SIMPLE CLASSIFIERS OF SATELLITE DATA FOR HYDROLOGIC MODELLING,
University Coll., Cardiff (Wales).
R. S. Drayton, T. R. E. Chidley, and W. C. Collins.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 709-711, 1 tab, 1 fig, 4 ref.

Descriptors: *Landsat images, *Satellite technology, *Model studies, *Remote sensing, *Hydrologic models, Data processing, Monitoring, Runoff, Runoff Forecasting, Mathematical models.

The use of parameters derived from satellite imagery thematic classifications for hydrologic modelling is discussed. The advantage of this technique is that the satellite image becomes an up-to-date, easily managed source of data for monitoring water resources. A model was constructed in which run-off characteristics were regressed on thematic classifications using spectral characteristics as the parameters. The various slices and classifications enabled many different partitionings of the catchments to be made; however, when the

proportions in each classification were calculated, the difference between the methods of classification became less obvious. Secondly, many strong correlations occurred between variables. The modelling attempt failed because the variance of the hydrological characteristics from the area contained in one Landsat frame was too small. In order to achieve greater variance, data would have to be drawn from more than one image, but the problems of achieving homogeneity in data from different images and different dates appears to be insurmountable. (See also W89-08577) (White-Reimer-PTT)
W89-08588

DELINEATION AND CLASSIFICATION OF INLAND WETLANDS UTILIZING FCIR STEREO IMAGERY,
For primary bibliographic entry see Field 7B.
W89-08589

HYDROLOGICAL COMPARISON OF LANDSAT TM, LANDSAT MSS AND BLACK & WHITE AERIAL PHOTOGRAPHY,
Aston Univ., Birmingham (England).
For primary bibliographic entry see Field 7A.
W89-08590

REMOTE SENSING OF FLOW CHARACTERISTICS OF THE STRAIT OF ORESUND,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
L. Jonsson.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 725-729, 13 fig, 4 ref.

Descriptors: *Remote sensing, *Flow pattern, *Strait of Oresund, Satellite technology, Data acquisition, Data processing, Data interpretation, NOAA imagery, Landsat imagery, Model studies, Mathematical models, Hydrologic models, Mapping, Flow characteristics, Straits, Sweden.

The use of expand National Oceanographic & Atmospheric Administration and Landsat imagery for obtaining information on the large-scale flow pattern and the possibility of distinguishing certain flow phenomena for the strait of Oresund is discussed. Digital NOAA data and Landsat Thermatic Mapper data were contrast-stretched on an EBBA-II image processing system and water surface temperatures and suspended material were used to determine water movements and to differentiate water masses. The two methods resulted in comparable flow information for the area and the effects of specific industrial activities and currents on flow characteristics were observed. In addition, by using the laterally integrated flow equations, the effect was studied on the circulation and salinity contents of the strait of the proposed tunnel on the bottom between Helsingborg and Helsingor. The results obtained by comparing the model predictions with the remote sensing information indicate that the useful aspects of satellite flow information in numerical modeling include: choosing an appropriate form of approximating the hydrodynamic equations; discerning important flow mechanisms that should be modelled; choosing suitable boundaries for detailed flow computation; obtaining flow characteristics on the model boundaries; calibration and validation; and determining density and distribution of grid points. (See also W89-08577) (White-Reimer-PTT)
W89-08592

PRESENT STATE, CHANGES AND QUALITY OF SOLOGNE AND BRENNE, TWO FRENCH LARGE WETLANDS, STUDIED WITH THE MSS AND TM LANDSAT DATA,
Ministere de l'Environnement et du Cadre de Vie, Neuilly-sur-Seine (France).
M. Lenco, and J. P. Dedieu.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 731-732, 2 tab.

Descriptors: *Brenne wetlands, *Sologne wetlands, *Remote sensing, *Wetlands, *Mapping, *France, Landsat TM, Landsat MSS, Aerial photography, Data acquisition, Data processing, Data interpretation, Satellite technology, Decision making, Administrative decisions, Turbidity, Aquatic plants, Temperature.

Landsat Thematic Mapper and Multispectral Scanner data was collected for the Brenne and Sologne wetlands, located in central France, in order to provide the local administrative and scientific authorities with information needed for decisions concerning the protection and use of the wetlands. An improved and restored false colorimage was elaborated for each survey date. The resulting image was interpreted for land use with the aid of topographical, geological, and vegetation maps, and available aerial photographs. Initially, cartographical (at 1/50,000 scale) and numerical information covering 23 catagories was obtained on present conditions and changes since 1975. Secondly, it was possible to determine the depth, turbidity, temperature, and aquatic vegetation for aquatic areas. (See also W89-08577) (White-Reimer-PTT)
W89-08593

QUANTIFICATION OF FLOODPLAIN INUNDATION BY THE USE OF LANDSAT AND METRIC CAMERA INFORMATION, BELIZE, CENTRAL AMERICA,
Aston Univ., Birmingham (England).
S. T. Miller.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 733-738, 5 tab, 6 fig, 6 ref.

Descriptors: *Data interpretation, *Remote sensing, *Flooding, *Central America, *Surveys, Flood data, Flood forecasting, Flood hydrographs, Flood plain management, Flood channels, Flood profiles, Landsat imagery, Aerial photography, Metric Camera imagery, Belize.

An investigation was made into the quantification of a flood event using a single post-flood Landsat 3 image aided by basic topographic and hydrological information. Comparisons were made between Landsat, Metric Camera and ground survey data to assess the contribution that space borne remote sensing can make where limited ground-truth is available. For the upper floodplain the Landsat imagery indicated at least 5 overspill locations and displayed the distribution of floodwaters and the affected areas. The Landsat imagery with the aid of basic spot height data also provided flood volume estimates that were similar to those obtained from flood hydrographs from the 1979 flood. The ground survey with aerial photographs did not reveal this information. Although quantitative flood assessments were not possible for the lower floodplain, the Landsat image was in agreement with the ground survey and showed that flood water was present. However, the Landsat image indicated a greater volume of water and identified the channel routes the floods take. There was similar agreement with the Metric Camera imagery. The multitemporal imagery combined with supplementary data can provide detailed insights to flood processes and provide estimates of flood volumes. (See also W89-08577) (White-Reimer-PTT)
W89-08594

ENVIRONMENTAL ASSESSMENT FOR LARGE SCALE CIVIL ENGINEERING PROJECTS WITH DATA OF DTM AND REMOTE SENSING,
Hosei Univ., Tokyo (Japan). Faculty of Engineering.
T. Oshima, A. Rikimaru, Y. Kato, and M. Nakamura.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 745-748, 2 tab, 1 fig.

Descriptors: *Remote sensing, *Environmental effects, *Geohydrology, Landslides, Satellite technology, Digital terrain model, Mapping, Surveys, Maximum-likelihood method, Similarity analysis, Granites, Reservoir sites, Damsites, Japan, Relocation.

In order to manage and analyze numerical topography, or Digital terrain model (DTM) and remote sensing data for a water resources dam and reservoir development management project, conditions such as topography, geology, vegetation, and water resources of the project area were first analyzed with the DTM and remote sensing data. Using this initial information the estimation mapping for grade of weathered granite and the degree of landslide danger were analyzed by the 'Maximum-likelihood method' and the 'Similarity analysis.' This information resulted in the delineation of the landslide danger area, and the identification of the grade of weathered granite in the area. Using this information, simulations were carried out to determine an optimum relocation site for people living in the project area. (See also W89-08577) (White-Reimer-PTT)
W89-08596

SATELLITE DATA IN AQUATIC AREA RESEARCH: SOME IDEAS FOR FUTURE STUDIES,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 7A.
W89-08597

ANALYSIS OF LANDSAT MULTISPECTRAL-MULTITEMPORAL IMAGES FOR GEOLOGIC-LITHOLOGIC MAP OF THE BANGLADESH DELTA,
International Inst. for Aerospace Survey and Earth Sciences, Enschede (Netherlands).
A. Sesoren.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 759-764, 4 fig, 16 ref.

Descriptors: *Remote sensing, *Satellite technology, *Flood plains, *Deltas, *Mapping, Geology, Lithology, Geomorphology, Temporal distribution, Landsat images, Spatial distribution, Vegetation, Spectral distribution, Bangladesh Delta.

Geological interpretation of Landsat images of delta areas is very difficult because the delta deposits are lithologically very similar. They do not produce identifiable morphologic features, and they are not even well exposed because of dense vegetation cover during most of the year. However, by applying a hierarchical classification of the delta areas based on genetic classes, geomorphological units, and on spectral, spatial and temporal characteristics of materials, a lithologic-geologic interpretation is possible. By subdividing the delta into different types of flood plains, deposits that were developed under distinct conditions will also be separated, and genetic classes of sediments obtained. A major river in flood normally deposits different amounts and types of sediments in different parts of its flood plain in a well-known sequence ranging from sandy to silty to loam and clay. Changes in landscape patterns and differences in spectral signatures allow a subdivision of the river flood plain into geomorphological sub-classes. Since patterns differ in different locations in tidal flood plains due to types of material in relation to topographical differences, the tidal flood plain can be subdivided into a number of lithologic groups by analyzing the landscape pattern and colors on the images from different dates. The composite flood plain, which is found between the tidal and river flood plains, is situated far from the main rivers and active channels. This flood plain can be identified by the dark color, as a result of its continuously saturated condition, on images from different years. Further subdivisions are possible within each major category. (See also W89-) (White-Reimer-PTT)
W89-08598

WATER QUALITY MONITORING OF LAKE BALATON USING LANDSAT MSS DATA,
Tokai Univ., Hiratsuka (Japan). Research and In-

formation Center.
H. Shimoda, M. Etaya, T. Sakata, L. Goda, and K. Stelczer.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 765-770, 2 tab, 9 fig, 2 ref.

Descriptors: *Lake Balaton, *Remote sensing, *Monitoring, *Water quality, Satellite technology, Landsat MSS, Surveys, Lakes, Data acquisition, Data processing, Correlation analysis, Hungary, Transparency, Chlorophylla.

Water quality monitoring was conducted for Lake Balaton in Hungary using Landsat Multispectial Scanner data and simultaneous ground truth measurements. Fourteen water quality parameters were measured at thirty sites. Following preprocessing of the MSS data, linear multi regression analyses were made between MSS data and ground truth data. Nine water quality parameters showed correlations with the MSS data with transparency, chlorophyll-a, UV extinction, and oxygen saturation showing the strongest correlations. No correlations were found for suspended solids, water temperature, and ratios of acid soluble magnesium and phosphorus. The mean values of 3x3 pixel windows were the most desirable signature, and although there have been reports of using band to band ratios for water quality monitoring, this relationship was not observed in this study. (See also W89-08577) (White-Reimer-PTT)
W89-08599

CLASSIFICATION OF BOTTOM COMPOSITION AND BATHYMETRY OF SHALLOW WATERS BY PASSIVE REMOTE SENSING,
Nederlands Inst. voor Onderzoek der Zee, Texel.
D. Spitzer, and R. W. J. Dirks.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 775-777, 5 fig, 3 ref.

Descriptors: *Data interpretation, *Remote sensing, *Mapping, *Bathymetry, Satellite technology, Algorithms, Depth, Optical properties, Reflectance, Bottom sediments, Model studies, Upwelling, Two-flow radiative transfer model, Landsat images.

In areas where the visible light penetration depth exceeds the bottom depth the reflectance of solar radiation contains information about the composition of the water column as well as about the bottom. When mapping the bottom depth and composition, specific algorithms must be developed in order to remove the influence of the water column on the upwelling optical signals. Using calculations relating the reflectance spectra to the parameters of the water column and the diverse bottom types, and measurements of the underwater reflection coefficient of sandy, mud and vegetation-type seabottom, a two-flow radiative transfer model was employed in which the spectral signatures of suspended and dissolved materials and the bottom were introduced as the input parameters. In investigating the algorithms for the bottom depth and for the bottom composition assessment, it was determined that the requirements for the applicability of each type differ. An optimal bottom depth algorithm should be insensitive to the variation of the bottom and watercolumn composition, while a bottom composition algorithm should be insensitive to the watercolumn structure, including the depth. Logarithmic transformation of the differences between the shallow-water and the deep-water reflectances appears to be advantageous due to the exponential depth dependence of the irradiance. The application of Landsat MSS, TM and SPOT HRV scanners to several proposed algorithms is discussed. (See also W89-08577) (White-Reimer-PTT)
W89-08601

SATELLITE REMOTE SENSING OF THE COASTAL ENVIRONMENT OF BOMBAY,
Indian Inst. of Tech., Bombay.
V. Subramanyan.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 779-781, 3 fig, 5 ref.

Descriptors: *Geomorphology, *Remote sensing, *Mapping, *Shores, *India, *Erosion, Satellite technology, Coasts, Geologic erosion, Geological fractures, Beaches, Retrogradation, Bombay, Topography.

The development and evolution of the Bombay coast was traced by means of remote sensing using Landsat imagery (black and white and false-color paper prints). The coast is indented by many bays, promontories, creeks, tidal mudflats, stacks and beaches which is indicative of a retrogradation cycle in which marine processes gradually convert the initially straight coastline into a highly irregular, indented shoreline. All the creeks follow lineaments and there is a triple junction of such lineaments to the east of Bombay that clearly indicates the erosional development of the region by fluviomarine processes. Using topographical maps local details have been added and the interpretation of the imagery confirmed. The raised beaches, the littoral concrete and the marshes indicate a period of emergence of the Bombay region sometime in the past. This may have occurred in conjunction with the coastal faulting which is thought to have taken place all along the West Coast after the eruption of the Deccan Volcanics and resulted in a straight coastline. It is expected that the retrogradation cycle will result in the elimination of the bays and promontories and the original straight configuration will be restored in a few million years. (See also W89-08577) (White-Reimer-PTT)
W89-08602

STUDY WITH NOAA-7 AVHRR-IMAGERY IN MONITORING EPHEMERAL STREAMS IN THE LOWER CATCHMENT AREA OF THE TANA RIVER, KENYA,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 7A.
W89-08603

SIMPLE ATMOSPHERIC CORRECTION ALGORITHM FOR LANDSAT THEMATIC MAPPER SATELLITE IMAGES,
Koninklijk Museum voor Midden-Afrika, Tervuren (Belgium).
P. I. G. M. Vanouplines.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 787-791, 6 tab, 2 fig, 16 ref.

Descriptors: *Remote sensing, *Monitoring, *Mathematical studies, *Satellite technology, Water quality, Landsat imagery, Landsat Thematic Mapper, Algorithms, Data acquisition, Data processing, Sensitivity analysis.

The development of an atmospheric correction algorithm for Landsat Thematic Mapper based on a 'simple' algorithm proposed by Sturm is described. The algorithm is called simple because it only needs one meteorological variable, the meteorological range (or horizontal visibility) which is easily obtained from meteorological stations and airports. The developed algorithm was tested with a sensitivity analysis for the influence of changes in the following variables: visibility range; solar zenith angle; ozone optical thickness; and solar extraterrestrial irradiance. The results of this analysis indicate the algorithm is applicable in regions with stable and well measured atmospheric conditions, and can be applied on images taken months or even years ago since horizontal visibility can be easily retrieved from meteorological time series. For water quality applications it might be necessary to cluster 4x4 pixels to increase the signal to noise ratio, but even then the resolution is considerably better than for the Nimbus-7 Coastal Zone Color Scanner namely 120 m. (See also W89-08577) (White-Reimer-PTT)
W89-08604

APPLICATION OF PHYSIOGRAPHIC PHOTO INTERPRETATION TECHNIQUE TO ANALYSE THE ENIGMATIC DRAINAGE PROBLEM OF THE HYDERABAD METROPOLITAN REGION, PAKISTAN,
Soil Survey of Pakistan, Lahore.
M. N. Syal, and I. E. Schneider.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 873-879, 4 fig, 18 ref.

Descriptors: *Aerial photography, *Urban drainage, *Urbanization, *Urban planning, *Pakistan, *Drainage patterns, *Drainage systems, Geohydrology, Regional development, Regional planning, Mapping, Soil stability, Physiographic balance, Hyderabad Metropolitan Region, Sewer system.

The region around Hyderabad, Pakastan is characterized by flat rocky plateaus, flood plains, and Piedmont plains situated along the Indus River. Due to rapid population increases and a lack of comprehensive urban planning, the region's natural drainage system has deteriorated. In order to provide information for a solution, aerial photographs for the area were interpreted, and the deterioration causes were correlated with physiographic processes. The rate of deterioration was determined by comparing two sets of aerial photographs taken at a 23 year interval. It was observed that the spatial growth and the degree of deterioration were attributable to the technically fragile physiographic positions. Most of the open areas available for urban expansion adjacent to the existing civic infrastructure are associated with drainage problems. Without provisions for adequate surface and subsurface drainage, this area is likely to experience collapsing sewer systems as a result of sloughing action. Other areas receive runoff from adjoining rocks, have restricted subsurface water flow, and perched water table conditions that require proper arrangements for the disposal of drainage water. In order to develop the open areas around the saddle between the rock outcrops, natural drainage channel remnants have to be developed throughout their courses. These courses are traceable on aerial photographs. Since drainage is associated with particular soil types, large-scale aerial photographs should be studied for variations in moisture content. (See also W89-08577) (White-Reimer-PTT)
W89-08605

POTENTIAL OF NUMERICAL AGRONOMIC SIMULATION MODELS,
Centre for World Food Studies, Wageningen-Amsterdam, The Netherlands.
J. A. A. Berkhout.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 907-911, 1 tab, 4 fig, 27 ref.

Descriptors: *Remote sensing, *Model studies, *Agronomy, *Cropland, *Monitoring, Stochastic models, Deterministic models, Satellite technology, Data Base Management Systems, Geographic Information System, Simulation models, On-site investigations, Cultivated lands.

The possibility of reducing the required ground truth data for remote sensing image interpretation by developing numerical simulation models on plant and crop growth, within the framework of a Geographic Information System, is discussed. The use of remote sensing images will introduce the possibility of monitoring actual crop growth and help detect 'problem areas.' The type of model applied depends on the selected features or attributes of the land and the farming system modeled. In order to link numerical simulation techniques with remote sensing, it is necessary to determine the attributes that can be observed and quantified with remote sensing and can also be used as forcing or calibration variables in the models. Although the operational satellites have not been designed specifically for the quantitative assessment of most of the relevant variables, the following variables can be derived from remote sensing information: actual precipitation; actual irradiance; air temperature; and actual evapotranspiration. The main objective of a Data Base Management

System is to organize the information within the Geographic Information System developed in a manner that allows the user to extract and analyze data sets and to derive new information in respect to the selected geographical location or areas. Although extensive field observations are required to quantify the combined effect of all land entities and farm practices on the cultivation of specific crops, the number of observations can be reduced by using numerical simulation models that have been calibrated over a number of years. (See also W89-08577) (White-Reimer-PTT)
W89-08606

COMPREHENSIVE LRIS OF THE KANANASKIS VALLEY USING LANDSAT DATA,
Calgary Univ. (Alberta).
G. D. Lodwick, S. H. Paine, M. P. Mepham, and A. W. Colijn.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 927-932, 2 tab, 5 fig, 26 ref.

Descriptors: *Data processing, *Data storage and retrieval, *Computer programs, *Computers, *Land use, Mapping, Satellite technology, Landsat imagery, Land Related Information System, VAX 11/750 computer, VAX/DBMS system, CODASYL.

The design and development of a general land-related information system (LRIS) covering the upper Kananaskis Valley of southwestern Alberta using Landsat data information on surface cover, principle vegetation, and land use, as well as, overlays of thematic data obtained from conventional sources of geology, topography, snow-cover, hydrology, and pedology is described. The land information is stored on a VAX 11/750 computer system using VAX/DBMS, a Committee on Data System Languages data base management system. The primary key is the position-based data defined by the geographic coordinates of the various data types, but information retrieval by various secondary keys is also possible. In addition, topological relationships have been incorporated into the LRIS design to allow data retrieval in both graphical and tabular form. (See also W89-08577) (Author's abstract)
W89-08607

LAND RESOURCE USE MONITORING IN ROMANIA, USING AERIAL AND SPACE DATA,
Institutul de Geodezie, Fotogrammetrie, Cartografie si Organizarea Teritoriului, Bucharest (Romania).
N. Zegheru.
IN: Symposium on Remote Sensing for Resources Development and Environmental Management, Enschede, August 1986. Volume Two. A.A. Balkema, Boston. 1986. p 953-956, 4 fig, 7 ref.

Descriptors: *Remote sensing, *Land use, *Data processing, *Mapping, Computers, Planning, Future planning, Regional planning, Digital mapping, Satellite technology, Landsat imagery, Histograms, Romania.

Using land cadastre of Romania based on photogrammetric maps, automatic cadastral mapping using analytical photogrammetric methods, and data base storage systems, present land use was determined, and future land use planning stategies projected examined. Input data for the digital mapping system can be derived from topographic and photogrammetric surveys, existing maps or document digitizing, and photogrammetric and remote sensing data. The advantages of the digital mapping system include the simplification of map updating, maintenance of accuracy in new and modified elements introduced in the original map, and simplification of the map compilation when several aspects are combined. This system can be used for monitoring land evolution within hydromeliorative systems, land use within settlements, and waste dump sites. The method developed to automatically process remote sensing digital multispectral data uses zone pixel selection in CCT Landsat strips and radiometric measures introduced into a file, general pixel population histogram development, separation of selected classes on a histogram, and a printed histogram for each class. These classified images can then be graphed at a specified scale using a plotter. (See also W89-08577) (White-Reimer-PTT)
W89-08608

SYMPOSIUM ON REMOTE SENSING FOR RESOURCES DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT, ENSCHEDE, AUGUST 1986.
For primary bibliographic entry see Field 7A.
W89-08609

HYDROLOGIC AND OCEANOGRAPHIC APPLICATIONS OF REMOTE SENSING,
Dundee Univ. (Scotland). Physics Lab.
For primary bibliographic entry see Field 7B.
W89-08610

STATISTICAL ANALYSIS OF AQUIFER-TEST RESULTS FOR NINE REGIONAL AQUIFERS IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08636

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA: PHASE 3--DEVELOPMENT OF A THREE-DIMENSIONAL DIGITAL GROUND-WATER FLOW MODEL FOR STORAGE UNIT I OF THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08646

APPLICATION OF THE PRECIPITATION-RUNOFF MODELING SYSTEM TO SMALL BASINS IN THE PARACHUTE CREEK BASIN, COLORADO,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08652

POTENTIOMETRIC SURFACE, GROUND-WATER WITHDRAWALS, AND RECHARGE AREA FOR THE NANAFALIA-CLAYTON AQUIFER IN ALABAMA, FALL 1982,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08653

POTENTIOMETRIC SURFACE, GROUND-WATER WITHDRAWALS, AND RECHARGE AREA FOR THE LISBON AQUIFER IN ALABAMA, FALL 1982,
Geological Survey, Tuscaloosa, AL.
For primary bibliographic entry see Field 2F.
W89-08654

SIMULATION OF GROUND-WATER FLOW AND INFILTRATION FROM THE SUSQUEHANNA RIVER TO A SHALLOW AQUIFER AT KIRKWOOD AND CONKLIN, BROOME COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08655

HYDROLOGIC DATA FROM THE JOHNSON BROOK PHOSPHORUS LOADING STUDY, KENNEBEC COUNTY, MAINE, MARCH 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 5G.
W89-08656

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN SOUTH DAKOTA AND PARTS OF ADJACENT STATES,
M. E. Cooley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-548, 1983. 1 p (map), 6 ref.

Descriptors: *Hydrologic maps, *Geologic fractures, *Geohydrology, *Satellite technology, *Remote sensing, Maps, South Dakota, Groundwater movement.

This map is one of a series of linear features maps compiled for the U.S. Geological Survey's Northern Great Plains Regional Aquifer System Analysis. The map shows the linear features that were recognized in South Dakota. The linear features shown on this map are not identified as to type or origin, although most probably reflect fractures or fracture zones, including joints and faults. Fracture zones affect the movement of water and other fluids through the rocks. The linear features were determined from visual inspection of color-infrared composites of Landsat imagery at a scale of 1:500,000. (Lantz-PTT)
W89-08664

GROUND-WATER DATA FOR GEORGIA, 1982,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08665

GROUNDWATER QUALITY DATA FOR OKLAHOMA-1981,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08667

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1983,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08668

COMPILATION AND PRELIMINARY INTERPRETATION OF HYDROLOGIC DATA FOR THE WELDON SPRING RADIOACTIVE WASTE-DISPOSAL SITES, ST. CHARLES COUNTY, MISSOURI--A PROGRESS REPORT,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08680

THREE-DIMENSIONAL STEADY-STATE SIMULATION OF FLOW IN THE SAND-AND-GRAVEL AQUIFER, SOUTHERN ESCAMBIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08681

TWO-CONSTITUENT SOLUTE-TRANSPORT MODEL FOR GROUND WATER HAVING VARIABLE DENSITY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08682

(WATER RESOURCES MAPS OF THE REELFOOT STATE WILDLIFE MANAGEMENT AREA, REELFOOT LAKE AND IMMEDIATE ENVIRONS).
Geological Survey, Knoxville, TN. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water

Resources Investigations Report 85-4097, (1985). 9p, 9 maps.

Descriptors: *Maps, *Watersheds, *Reelfoot Lake, *Water resources data, *Tennessee, Water level, Rainfall, Groundwater budget, Wetlands, Hydrologic models, Groundwater level.

Nine maps describe the following water resources aspects of the Reelfoot Lake watershed: Map 1-Surface water gaging stations, lake level, and locations of observation wells, rainfall stations and National Weather Service rainfall stations; Maps 2 and 3-water level contours, river stage, groundwater movement; Maps 4 and 5-grid blocks simulating constant head on the Mississippi River, Reelfoot Lake, Running Reelfoot Bayou, Reelfoot Creek, and Running Slough; Maps 6 and 7-difference between model calculated and observed water levels; and Maps 8 and 9-line of equal groundwater level increase and approximate lake area at pool elevation. (Lantz-PTT)
W89-08716

AQUIFER MODEL OF THE SUSQUEHANNA RIVER VALLEY IN SOUTHWESTERN BROOME COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08717

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, APALACHICOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4131, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Apalachiola area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08723

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, DAYTONA BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4132, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Dayton Beach area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08724

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, FORT PIERCE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4133 1986. 1p (map), 3 ref.

Descriptors: *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, *Network design, *Florida, *Maps, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Fort Pierce area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08725

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, GAINESVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4134, 1986. 1p (map), 3 ref.

Descriptors: *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Florida, *Network design, *Maps, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Gainesville area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08726

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS JACKSONVILLE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4135, 1986. 1p (map), 3 ref.

Descriptors: *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Network design, *Mapst, *Florida, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Jacksonville area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08727

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, KEY WEST 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4136, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Key West area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08728

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, MIAMI 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,

M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4137, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Miami area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08729

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, ORLANDO 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4138, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Orlando area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08730

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, PENSACOLA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4139, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Pensacola area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08731

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, TALLAHASSEE 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4140, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Tallahassee area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08732

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, TAMPA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4141, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Tampa area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08733

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, TARPON SPRINGS 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4142, 1986. 1p (map), 3 ref.

Descriptors: *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Network design, *Maps, *Florida, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Tarpon Springs area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08734

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, VALDOSTA 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4143, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the Valdosta area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08735

LOCATION OF POTENTIAL GROUNDWATER QUALITY MONITORING WELLS, WEST PALM BEACH 1 DEGREE X 2 DEGREE QUADRANGLE, FLORIDA,
M. E. Thagard, and P. R. Seaber.
Available from Books and Open File Report Sec-

tion, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report WRIR 85-4144, 1986. 1p (map), 3 ref.

Descriptors: *Network design, *Maps, *Florida, *Groundwater quality, *Hydrologic data collections, *Data acquisition, *Monitoring wells, Wells, Groundwater.

This quadrangle map is one of 14 U.S. Geological Survey (USGS) quadrangle maps at a scale of 1:250,000 that shows the location of potential groundwater quality monitoring wells in Florida. The statewide coverage of these quadrangle maps is shown on the location diagram. Cumulatively, the 14 maps show 1,846 well locations and represent the results of part of a cooperative Federal-State investigation to design a groundwater quality data base for Florida. This map covers the West Palm Beach area. The wells were identified using data stored in the USGS computer and meet the selection criteria of known location, depth, diameter, aquifer tapped, and sampled during the period of January 1970 through October 1982. The well locations are cross-referenced by plot number between the maps and companion report. Some plot numbers represent more than one well. These are wells that are less than 1 minute of latitude and longitude from one another or located approximately within a circle having a 1-mile diameter. (Lantz-PTT)
W89-08736

DOCUMENTATION OF A REGIONAL AQUIFER SIMULATION MODEL, RAQSIM, AND A DESCRIPTION OF SUPPORT PROGRAMS APPLIED IN THE TWIN PLATTE-MIDDLE REPUBLICAN STUDY AREA, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08747

GROUND-WATER LEVELS IN THE COCKEYSVILLE MARBLE OF SOUTHERN CHESTER COUNTY, PENNSYLVANIA, 1983-84,
D. W. Speight.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4341, 1985. 1p (map).

Descriptors: *Groundwater level, *Hydrologic maps, *Geohydrology, *Maps, *Pennsylvania, Cockeysville marble, Hydrologic data collection, Carbonate rocks.

This geohydrologic map highlights groundwater levels, and indicates: locations between carbonate and noncarbonate rocks; water table; and splits between contact where the marble has been cut by pegmatite dikes. (Lantz-PTT)
W89-08758

GEOLOGY OF THE '20-FOOT' CLAY AND GARDINERS CLAY IN SOUTHERN NASSAU AND SOUTHWESTERN SUFFOLK COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08763

HYDROLOGIC MAPS OF THE HIGH PLAINS AQUIFER, JANUARY 1981, SOUTHWESTERN KANSAS,
J. M. Spinazola.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 82-4079, 1983. 8p, 8p maps, 5 ref.

Descriptors: *Geohydrology, *Water resources data, *Hydrologic maps, *Groundwater level, Plains aquifer, Maps, Kansas, Kriging, Water table, Aquifers, Groundwater budget, Geohydrology.

Kriging was used in the form of a computer program to interpolate hydrologic data based on a network of measured values in west-central Kansas with good results. The program calculates values at the center of each 1-mile section in a predefined region and facilitates contouring of selected values. The kriging technique was used to produce the hydrologic maps in this report. The principal source of groundwater for agricultural, industrial, and municipal use in southwestern Kansas is the High Plains aquifer. The aquifer consists of interbedded calcium carbonate-cemented sand (mortar beds) of Miocene age (Ogallala Formation) and Pliocene age (undifferentiated deposits) and ranges in thickness from zero to 600 ft. Depths to water in wells range from about 50 to > 300 ft. Discharge from wells ranges from 50 to 1,200 gallons/minute. The maps illustrate hydrologic conditions as they existed during January 1981 in the High Plains aquifer in southwestern Kansas. Maps of the aquifer include altitude of the water table and saturated thickness of the aquifer. (Lantz-PTT)
W89-08764

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY FOR WATER-YEAR 1982,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W89-08767

WATER LEVEL AND SATURATED THICKNESS MAPS OF THE ALLUVIAL AQUIFER IN EASTERN ARKANSAS, 1984,
Geological Survey, Little Rock, AR. Water Resources Div.
M. Plafcan, and J. Edds.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4014, 1986. 1p, 2 fig, 4 maps, 12 ref.

Descriptors: *Groundwater level, *Alluvial aquifers, *Arkansas, *Pumpage, Agriculture, Groundwater depletion, Seasonal variation, Groundwater budget, Aquifers.

The Mississippi River Valley alluvial aquifer, is a major source of water for most of eastern Arkansas. Agriculture is largely dependent on the aquifer as approximately 3.3 billion gallon per day are withdrawn for that purpose. Much smaller withdrawals also occur for industrial, public supply, and domestic use. The purpose of the report is to illustrate, using the spring and fall potentiometric surface maps, the water levels in the alluvial aquifer under pre-pumping and post-pumping conditions, respectively, and to illustrate, using the depth-to-water and saturated thickness maps, the effect of heavy pumpage in the alluvial aquifer. (Lantz-PTT)
W89-08771

POTENTIOMETRIC MAP OF THE MERIDIAN-UPPER WILCOX AQUIFER IN MISSISSIPPI, FALL 1983,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4018, 1986. 1p (map), 9 fig, 3 ref.

Descriptors: *Potentiometric level, *Hydrologic maps, *Maps, *Meridian-Upper Wilcox Aquifer, *Mississippi, Aquifers, Groundwater level, Groundwater budget, Groundwater recharge.

The Meridian-upper Wilcox aquifer consists of the Meridian Sand member of the Tallahatta Formation and the uppermost sand beds of the Wilcox Group. Thickness of the aquifer ranges from 50 ft to 500 ft. Precipitation recharges the Meridian-upper Wilcox in the outcrop area, which extends from Benton County, MS, in the north to Clarke County, MS, in the south. The potentiometric map is based on water level measurements made in about 170 wells in the Meridian-upper Wilcox aquifer in October 1983, and on the approximate altitudes of water surfaces in some major streams. The contours show altitudes at which water levels would have stood in tightly cased unpumped wells. This map, the second in the series for the Meridian-upper Wilcox aquifer, updates a map that delineated the potentiometric surface of the aquifer in 1979. (Lantz-PTT)
W89-08773

NUMERICAL SIMULATION OF ADVECTIVE-DISPERSIVE MULTISOLUTE TRANSPORT WITH SORPTION, ION EXCHANGE AND EQUILIBRIUM CHEMISTRY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08776

METHODS FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN MONTANA BASED ON DATA THROUGH 1983,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08778

WATER LEVELS IN MAJOR ARTESIAN AQUIFERS OF THE NEW JERSEY COASTAL PLAIN, 1983,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08779

CLUSTER ANALYSIS OF PHYTOPLANKTON DATA COLLECTED FROM THE NATIONAL STREAM QUALITY ACCOUNTING NETWORK IN THE TENNESSEE RIVER BASIN, 1974-81,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. W . Stephens, and J. B. Wangsgard.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4029, 1986. 48p, 15 fig, 7 tab, 2 plates, 20 ref.

Descriptors: *Statistics, *Phytoplankton, *Tennessee River, *Statistical analysis, *Water quality, *Algae, Streams, Data interpretation, Computer programs, French Broad River, Algae, Diatoms, Chlorides, Dissolved solids, Biomonitoring, River basins, Biological samples, Data collections, Taxonomy.

A computer program, Numerical Taxonomy System of Multivariate Statistical Programs (NTSYS), was used with interfacing software to perform cluster analyses of phytoplankton data stored in the biological files of the U.S. Geological Survey. The NTSYS software performs various types of statistical analyses and is capable of handling a large matrix of data. Cluster analyses were done on phytoplankton data collected from 1974 to 1981 at four national Stream Quality Accounting Network stations in the Tennessee River basin. Analysis of the changes in clusters of phytoplankton genera indicated possible changes in the water quality of the French Broad River near Knoxville, Tennessee. At this station, the most common diatom groups indicated a shift in dominant forms with some of the less common diatoms being replaced by green and blue-green algae. There was a reduction in genera variability between 1974-77 and 1979-81 sampling periods. Statistical analysis of chloride and dissolved solids confirmed that concentrations of these substances were smaller in 1974-77 than in 1979-81. At Pickwick Landing Dam, the furthest downstream station used in the study, there was an increase in the number of genera of 'rare' organisms with time. The appearance of two groups of green and blue-green algae indicated that an increase in temperature or nutrient concentrations occurred from 1974 to 1981, but this could not be confirmed using available water quality data. Associations of genera forming the phytoplankton communities at three stations on the Tennessee River were found to be seasonal. Nodal analysis of combined data from all four stations

used in the study did not identify any seasonal or temporal patterns during 1974-81. Cluster analysis using the NYSYS programs was effective in reducing the large phytoplankton data set to a manageable size and provided considerable insight into the structure of phytoplankton communities in the Tennessee River basin. Problems encountered using cluster analysis were the subjectivity introduced in the definition of meaningful clusters, and the lack of taxonomic identification to the species level. (Author's abstract)
W89-08780

POTENTIAL FOR UPDIP MOVEMENT OF SALINEWATER IN THE EDWARDS AQUIFER, SAN ANTONIO, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08782

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF CRYSTALLINE-ROCK AQUIFERS OF ARCHEAN AND PROTEROZOIC AGE, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
H. W. Anderson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4033, 1986. 3p, 12 fig, 13 tab, 31 ref.

Descriptors: *Aquifer characteristics, *Hydrologic maps, *Geologic mapping, *Geohydrology, *Groundwater quality, *Aquifers, Minnesota, Groundwater movement, Dissolved solids, Rocks, Magnesium, Bicarbonate, Geologic formations, Geologic history.

Five aquifers in crystalline rocks of Archean and Proterozoic age in Minnesota include in descending order the North Shore Volcanic, Sioux Quartzite, Proterozoic metasedimentary, Biwabik Iron formation and undifferentiated Precambrian aquifers. The North Shore Volcanic aquifer generally yields < 15 gal/min to wells from interflow sediments and fractures in the basaltic lava flows along the northern shore of Lake Superior and along the upper St. Croix River. Dissolved solids concentrations range from 91 to 74,300 mg/L, and the water is of several chemical types. The Sioux Quartzite aquifer yields from 1 to 450 gal/min to wells open to joints and fractures and loose sand zones in the predominantly pink orthoquartzite in southwestern Minnesota. Dissolved solids concentrations range from 237 mg/L in water from wells in outcrop areas to 2,300 mg/L from wells where the Sioux Quartzite aquifer underlies Cretaceous rocks or thick Des Moines drift. The water generally is a calcium sulfate type. The Proterozoic metasedimentary aquifer generally yields < 20 gal/min to wells in weathered regolith and fractures in thin-bedded gray to black argillite in north-central Minnesota. Dissolved solids concentrations generally range from 126 to 340 mg/L, and the water is a calcium magnesium bicarbonate type. The Biwabik Iron formation aquifer yields 1,000 gal/min to wells in leached zones in the ferruginous chert and interbedded hematite and magnitite iron ore in north-central Minnesota. Dissolved solids range from 157 to 388 mg/L in water that is a calcium magnesium bicarbonate type. The undifferentiated Precambrian aquifer generally yields < 25 gal/min to wells from fractures and the weathered regolith developed on a variety of crystalline-rock types. Wells have been developed in parts of the aquifer throughout the State except in the southeast where it is too deeply buried. Dissolved solids concentrations average < 400 mg/L in central and northeastern Minnesota, but average about 700 mg/L in the northwest and 900 mg/L in the south west. The water is a calcium magnesium bicarbonate type in central and northeastern Minnesota and a variety of mixed water types in northwestern and Southwestern Minnesota. (Author's abstract)
W89-08783

GROUND-WATER AVAILABILITY IN THE BLACK RIVER BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
R. M. Waller.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4040, 1986. 3p, 3 maps, 9 ref.

Descriptors: *Groundwater availability, *Groundwater budget, *Hydrologic maps, *New York, Black River, Hydrologic data collections, Maps, Aquifers, Well yield, Geohydrology, Geologic mapping.

There are three maps in this set, which were prepared in 1966-68 as part of a study on the water resources of the Black River basin in cooperation with the New York State Department of Environmental Conservation. The data presented on the maps show well locations, well yield from bedrock aquifers, and well yield from unconsolidated aquifers. The well location map shows locations of all wells represented in the initial report. The well yields given on the bedrock aquifer map were recorrelated with the most recent New York State geologic maps; the well yields shown on the unconsolidated aquifer map are correlated with a surficial geology map of the area. (Lantz-PTT)
W89-08790

SURFICIAL GEOLOGY AND GROUNDWATER AVAILABILITY IN THE ALLEGHENY RIVER BASIN AND PART OF THE LAKE ERIE BASIN, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
M. H. Frimpter.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4041, 1986. 2p, 2 maps, 3 ref.

Descriptors: *Hydrologic maps, *Geologic mapping, *Groundwater availability, *New York, *Geohydrology, *Groundwater budget, *Alleghenny River, *Maps, *Lake Erie, Hydrologic data collections, Well yield, River basins, Lake basins.

New York State's need to develop a groundwater management program for protection of its aquifers led in 1985 to a cooperative program between the U.S. Geological Survey and the New York State Department of Environmental Conservation (through regional planning agencies) to publish data from previous studies. The two maps presented are from original compilations done in a 1967 study. Sheet 1 depicts the surficial geology as mapped in 1967; sheet 2 shows the groundwater availability (well yield) throughout the basin. These maps are presented at 1:250,000 scale for compatibility with published maps of adjacent river basins. (Lantz-PTT)
W89-08791

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1984,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4042, 1986. 1p, 1 map, 5 ref.

Descriptors: *Subsurface mapping, *Groundwater level, *Mississippi, *Aquifer characteristics, *Potentiometric level, *Cockfield Aquifer, *Hydrologic maps, *Mississippi, Hydrologic data collections, Aquifers, Groundwater budget, Maps.

This map, the second in a series for the Cockfield aquifer in Mississippi, follows a map that delineated the 1980 potentiometric surface of the aquifer. This water level map is based on water level measurements made in about 80 wells in the Cockfield aquifer in the fall of 1984. The contours show altitudes at which water levels would have stood in tightly cased unpumped wells in fall 1984. (Lantz-PTT)
W89-08792

GROUND-WATER LEVELS IN THREE BASALT HYDROLOGIC UNITS UNDERLYING THE COLUMBIA PLATEAU IN WASHINGTON AND OREGON, SPRING 1984,
K. J. Whiteman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4046, 1986. 4p, 3 fig, 3 maps, 9 ref.

Descriptors: *Geohydrology, *Subsurface mapping, *Geologic units, *Basalts, *Washington, *Oregon, *Groundwater level, *Hydrologic maps, Columbia River, Hydrologic data collections, Groundwater movement, Flow patterns, Groundwater irrigation, Groundwater recharge.

Groundwater level contour maps for three basalt units of the Columbia River Basalt Group were constructed for the Columbia Plateau in Washington and Oregon, using water levels measured at about 1,500 wells during spring 1984 and groundwater flow information developed for spring 1983 in the Washington part of the study area. The dominant pattern of groundwater movement in all three units indicates flow from higher elevations toward major surface drainage features. Variations in flow direction from one unit to the next appear to be related to depth of burial below overlying units. Upgradient flexures of water level contours north of Connell and south of Umatilla show effects of prolonged irrigation pumpage. Down gradient flexures in an area south of Potholes Reservoir in the vicinity of the East Low Irrigation Canal show the effects of increased man-induced recharge. (Author's abstract)
W89-08795

DUAL POROSITY MODEL FOR SIMULATING SOLUTE TRANSPORT IN OIL SHALE,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-08796

GROUND-WATER AVAILABILITY IN THE GENESEE RIVER BASIN IN NEW YORK AND PENNSYLVANIA,
Geological Survey, Ithaca, NY. Water Resources Div.
J. C. Kammerer, and W. A. Hobba.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4048, 1986. 4p, 4 maps, 4 ref.

Descriptors: *Groundwater availability, *Subsurface mapping, *Groundwater budget, *Hydrologic maps, *New York, *Pennsylvania, Genesee River, Maps, Aquifers, Hydrologic data collections, Geohydrology, Test wells.

New York State's need to develop a groundwater management strategy for the protection of its aquifers led, in 1985, to a cooperative program between the U.S. Geological Survey and the New York State Department of Environmental Conservation, through the Genesee/Finger Lakes Regional Planning Council, to publish basinwide groundwater availability maps. As a part of this program, several maps that had been compiled during the 1960s, were selected for publication through a grant between the State and several regional planning agencies. These maps depict the surficial geology and groundwater availability of the basin at 1:125,000 scale. Each map consists of two sheets; sheets 1 and 2 depict the groundwater availability and geology of the northern and southern parts of the basin, and sheets 3 and 4 depict well and test-hole locations within the northern and southern parts of the basin. (Lantz-PTT)
W89-08797

SIMULATION OF UNSTEADY FLOW IN THE MILWAUKEE HARBOR ESTUARY AT MILWAUKEE, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2H.

W89-08798

ALTITUDE OF THE FRESHWATER-SALTWATER INTERFACE IN A REGIONALLY EXTENSIVE COASTAL PLAIN AQUIFER OF MISSISSIPPI, ALABAMA, AND GEORGIA,
Geological Survey, Jackson, MS. Water Resources Div.
D. J. Strickland, and G. L. Mahon.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4058, 1986. 1p, 1 map, 14 ref.

Descriptors: *Coastal plains, *Hydrologic maps, *Saline-freshwater interfaces, *Coastal aquifers, *Geohydrology, *Mississippi, *Alabama, *Georgia, Dissolved solids, Water use, Groundwater level, Well logs, Computer models, Finite difference methods, Salinity.

Geophysical well logs from over 150 oil test and water wells in Mississippi, Alabama, and Georgia were examined and calculations of the dissolved solids concentration in ground water were made using the spontaneous potential deflection as a measure of ionic activity. The values derived from these calculations were used to prepare a map showing the altitude relative to sea level at which the concentration of dissolved solids in the groundwater reached 10,000 mg/L within a regionally extensive aquifer in Mississippi, Alabama, and Georgia. A dissolved solids concentration of 10,000 mg/L is used to delineate the interface between moderately saline and saline water; 10,000 mg/L dissolved solids was designated to delineate the freshwater-saltwater interface. For a finite difference computer flow model being used this interface represents the location where horizontal flow of freshwater is greatly diminished. 10,000 mg/L also is the lower limit for dissolved solids concentrations for water in target zones for injection wells. This 10,000 mg/L dissolved solids line is of value as a water quality indicator; although water containing 3,000 to 10,000 mg/L or more of dissolved solids is too saline for agricultural use (upper limit approximately 3,000 mg/L), it may be useful for some industrial purposes. Waters containing dissolved solids concentrations > 10,000 mg/L have little potential for any use involving human activities. (Lantz-PTT)
W89-08803

GENERALIZED POTENTIOMETRIC SURFACE OF THE CATAHOULA AQUIFER IN CENTRAL LOUISIANA, 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
A. Martin, and C. D. Whiteman.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 86-4059, 1986. 1p, 1 fig, 1 map, 17 ref.

Descriptors: *Groundwater level, *Potentiometric level, *Catahoula Aquifer, *Aquifer characteristics, *Hydrologic maps, *Louisiana, Maps, Aquifers, Hydrologic data collections, Saline water intrusion, Groundwater quality, Water table fluctuations.

Generalized contours of the altitude of water levels in wells completed in the Catahoula aquifer in central Louisiana, are illustrated by this map. Most water level measurements used in compiling the map were made in 1980; however, in parts of the State where water levels from 1980 were unavailable and where evidence indicated little change in water level, some measurements from as early as 1961 and as late as 1982 were used. Groundwater levels in and near the outcrop areas fluctuate 2 ft or less yearly and no significant long-term declines have occurred. The slow downward trend in water level altitude since early 1976 may be caused by pumpage from the Catahoula aquifer by a rural water system approximately 3 miles away. Recharge to the Catahoula aquifer occurs by rainfall on the upland outcrop-subcrop areas. Saltwater occurs throughout the Catahoula aquifer downgradient from the outcrop area. The 'approximate limit of freshwater' line on the map indicates the downgradient limit of water with a concentration of chloride < 250 mg/L; the line was determined using water quality data and analysis of resistivity curves from geophysical well logs. Water from the Catahoula aquifer is used for municipal, industrial, and domestic purposes. Total pumpage from the aquifer in Louisiana was slightly over 1.1 million gallons/day in 1980. Local cones of depression result from pumpage just east of Anacoco in Vernon Parish and northwest of Jonesville in Catahoula Parish. (Lantz-PTT)
W89-08804

SIMULATED EFFECTS OF PROJECTED PUMPING ON THE AVAILABILITY OF FRESHWATER IN THE EVANGELINE AQUIFER IN AN AREA SOUTHWEST OF CORPUS CHRISTI, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 6G.
W89-08807

MAPS SHOWING GROUND-WATER CONDITIONS IN THE COTTONWOOD CREEK AREA, SHASTA AND TEHAMA COUNTIES, CALIFORNIA, 1983-84,
Geological Survey, Sacramento, CA. Water Resources Div.
K. E. Evenson, and W. B. Kinsey.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4184, 1985. 1p, 3 fig, 2 tab, 8 ref.

Descriptors: *Hydrologic maps, *Groundwater level, *Maps, *Groundwater budget, *California, *Cottonwood Creek, *Groundwater quality, Groundwater recharge, Seasonal variation, Nitrates, Iron, Manganese, Dissolved solids, Baseline studies.

In September 1982, two groundwater monitoring networks were established in the Cottonwood Creek area. These networks were to monitor groundwater levels and groundwater quality in order to document baseline conditions prior to construction of two proposed dams: the Dutch Gulch Dam to be located on Cottonwood Creek and the Tehama Dam to be located on South Fork Cottonwood Creek. The groundwater level network is part of an ongoing monitoring program, whereas the groundwater quality network was discontinued in 1984. This report summarizes the second year of data (August 1983 to March 1984) for groundwater levels, and both years of data (October 1983 to May 1984) for groundwater quality. The groundwater quality monitoring network had 47 wells and samples were collected semiannually. Significant changes in water quality were not detected, and few wells exceeded U.S. EPA recommended limits for maximum concentrations of any constituent in domestic or irrigation water supplies. Constituents present in concentrations greater than EPA drinking water recommended limits were nitrate-nitrogen, iron, and manganese. Concentrations of dissolved solids were low in comparison to concentrations in groundwater throughout the northern Sacramento Valley, but were average for the Redding basin. (Lantz-PTT)
W89-08809

FLOOD OF OCTOBER 1983 IN SOUTHEASTERN ARIZONA-AREAS OF INUNDATION IN SELECTED REACHES ALONG THE GILA RIVER,
Geological Survey, Tucson, AZ. Water Resources Div.
J. M. Garrett, R. H. Roeske, and B. N. Bryce.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4225-A, 1986. 3p, 6 ref, 7 photos, 4 ref.

Descriptors: *Hydrologic maps, *Flooding, *Floods, *Gila River, *Arizona, Aerial photography, Flood forecasting, Flood routing, Flood profiles.

The flood of October 1983 on the Gila River from the head of Safford Valley to San Carlos Reservoir was the largest since at least 1906. This report documents an unusual flood on the Gila River by showing the inundated areas in selected reaches and by presenting information on runoff and flood frequency. The boundaries of the inundated areas will serve as an aid in estimating future flood risk. Flood boundaries were delineated along three reaches of the Gila River: (1) From the head of Safford Valley to San Carlos Reservoir, (2) from Winkelman to Kelvin, and (3) from Ashurst-Hayden Dam to the confluence with the Salt River. In the intervening reaches, the flow generally was confined to narrow canyons. Aerial photographs taken on October 7, 1983, were used to delineate the boundaries of the inundated areas along the Gila River. The boundaries were verified on the basis of other aerial photographs taken during and after the flood, interviews with local residents and other investigators, and onsite inspections. Several small islands of high ground within the boundaries may not have been inundated but are shown as inundated areas on the photomosaics because they could not be identified. (Lantz-PTT)
W89-08815

GROUND-WATER LEVELS IN THE LOWER PALEOZOIC CARBONATE ROCKS OF WESTERN CHESTER VALLEY, CHESTER COUNTY, PENNSYLVANIA, NOVEMBER 1984,
C. R. Wood.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4224, (1985). 1p, 1 map.

Descriptors: *Maps, *Groundwater level, *Carbonate rocks, *Chester County, *Pennsylvania, Groundwater budget, Water table, Wells.

One map describes the: (1) areas of contact between carbonate (contoured) and noncarbonate rocks; (2) line of equal water table altitude; (3) well locations; and (4) groundwater and water table profiles in western Chester County, PA. (Lantz-PTT)
W89-08816

WATER-QUALITY MAPS FOR SELECTED UPPER CRETACEOUS WATER-BEARING ZONES IN THE SOUTHEASTERN COASTAL PLAIN,
R. W. Lee.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4193, 1985. 2p, 2 fig, 12 maps, 36 ref.

Descriptors: *Subsurface mapping, *Coastal plains, *Water quality, *Maps, *Groundwater quality, *Coastal aquifers, *Georgia, *Alabama, *South Carolina, Aquifers, Bicarbonates, Sodium chloride, Dissolved solids, Iron, Chlorides, Saline water intrusion, Groundwater recharge, Groundwater movement.

Water quality maps of the three most prominent water bearing zones of the A4 aquifer in the southeastern Coastal Plain show the areal distributions of concentrations of dissolved solids, dissolved chloride, and dissolved iron, and hydrochemical facies. Dissolved solids, dissolved chloride, and dissolved iron concentrations increase from outcrop toward downgradient areas. Dissolved solids and dissolved chloride systematically increase farther downgradient, owing to mineral/water interactions and to the presence of saline water in the deeper parts of the water bearing zones of the A4 aquifer. Dissolved iron concentrations decrease farther downgradient, however, then increase again as the groundwater becomes more saline. There are three major hydrochemical factors in the water bearing zones of the A4 aquifer: calcium bicarbonate in the upgradient recharge areas, sodium bicarbonate downgradient from the recharge areas where waters contain dissolved solids concentrations ranging from 50 to 500 mg/L, and sodium chloride in the deep downgradient parts of the zone. The concentrations of dissolved solids and chloride appear to increase in groundwater discharge areas. Groundwater withdrawals near

Tupelo and West Point, MS, and Montgomery, AL, may have caused more saline water to move laterally from downgradient areas toward pumping centers. In Greene and Hale Counties, AL, discharge to the Sipsey and Black Warrior Rivers has apparently caused saline water in the deep parts of the zone to move upward. A similar effect is observed in northern Lowndes County, AL, with apparent discharge groundwater to the Alabama River. (Lantz-PTT)
W89-08817

LAND SUBSIDENCE IN THE SAN JOAQUIN VALLEY, CALIFORNIA, AS OF 1983,
For primary bibliographic entry see Field 6G.
W89-08819

GEOHYDROLOGY OF THE HIGH PLAINS AQUIFER, WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08821

SIMULATION ANALYSIS OF WATER-LEVEL CHANGES IN THE NAVAJO SANDSTONE DUE TO CHANGES IN THE ALTITUDE OF LAKE POWELL NEAR WAHWEAP BAY, UTAH AND ARIZONA,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08826

EVALUATION OF WATER-QUALITY DATA FROM HYDROLOGIC ACCOUNTING UNIT 051100, GREEN RIVER BASIN, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
D. W. Leist.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4208, 1986. 49p, 17 fig, 18 tab, 33 ref.

Descriptors: *Data interpretation, *Water quality, *Kentucky, *Data interpretation, *Green River, Specific conductivity, Hydrogen ion concentration, Phosphorus, Nitrogen, Chlorides, Sulfates, Iron, Water temperature, Suspended sediment, Water pollution sources.

Streamflow and water quality data collected by the U.S. Geological Survey (USGS) and the Kentucky Natural Resources and Environmental Protection Cabinet from 37 sites in the Green River basin were compared to data from the USGS National Stream Quality Accounting Network (NASQAN) Station, Green River near Beech Grove, Kentucky. This comparison was used to determine variability of water quality data throughout the basin, and to determine if water quality data from the NASQAN station were representative of water quality data upstream. Water quality concentrations, yields, and trends were studied. Water quality data from the NASQAN station were fairly representative conditions throughout the basin for specific conductance, pH, phosphorus and nitrogen, but were not representative for chloride, sulfate, iron, and water temperature. Water quality characteristics which were not representative can generally be attributed to impacts of specific land uses such as coal mining or oil production. Mean concentrations of suspended sediment were similar, but extreme concentrations varied throughout the basin. There were no temporal trends detected in instantaneous streamflow, sulfate, or total iron concentrations. Specific conductance was increasing at three stations and decreasing at one, chloride was increasing at two stations and decreasing at one, phosphorus was increasing at two stations, dissolved iron was increasing at one station and decreasing at one, pH was increasing at three stations and decreasing at two, suspended sediment was increasing at one station and decreasing at one, and water temperature was decreasing at two stations. The NASQAN station had increasing trends in chloride, phosphorus, pH, and suspended sediment, and a decreasing trend in water temperature with time. (Author's abstract)
W89-08827

ANALYSIS OF LONG-DURATION PIEZOMETRIC RECORDS FROM BURKINA FASO USED TO DETERMINE AQUIFER RECHARGE,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W89-08861

CURRENT STATE OF HYDROLOGIC MODELING AND ITS LIMITATIONS,
Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 2E.
W89-08864

UK FLOOD STUDIES REPORT: CONTINUING RESPONSIBILITIES AND RESEARCH NEEDS,
Institute of Hydrology, Wallingford (England).
M. Beran.
IN: Flood Hydrology: Proceedings of the International Symposium on Flood Frequency and Risk Analyses, 14-17 May 1986, Louisiana State University, Baton Rouge, U.S.A. D. Reidel Publishing Company, Boston, MA. 1987. p 27-39, 2 fig, 3 tab, 32 ref.

Descriptors: *Publications, *Handbooks, *Flood control, *Research priorities, Flood forecasting, Hydrologic data collections, Training, United Kingdom.

The UK Flood Studies Report was published in 1975 following four years of research by up to 25 specialists at four research centers. It contains flood estimation procedures now adopted as standard in the United Kingdom. Ten years of application remains unsurpassed for the scope of its recommendations, its exhaustive use of a national data set, and its translation of research methods into practical tools. Its acceptance into the UK water industry has been all but total. The main features and applications of the Report are reviewed and the importance is emphasized of a mechanism for after-sales servicing, for training, and for disseminating updates. Research into flood hydrology has continued in the UK and the continuing debates on issues raised are reported. Some special problems and responsibilities are discussed arising from applying research in an area where engineering and legal considerations may dominate. (See also W89-08863))(Author's abstract)
W89-08866

ASPECTS OF FLOOD LEVEL COMPUTATIONS,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2E.
W89-08874

SHOT-NOISE MODEL OF STREAMFLOW,
Kentucky Univ., Lexington. Dept. of Statistics.
For primary bibliographic entry see Field 2E.
W89-08875

SYNTHETIC FLOW GENERATION WITH STOCHASTIC MODELS,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W89-08877

REDUCTION OF UNCERTAINTIES IN THE FLOOD ESTIMATION IN THE CZECHOSLOVAK SECTION OF DANUBE RIVER,
Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W89-08878

REAL-TIME FLOOD FORECASTING IN THE RIVER SECTION WITH UNGAGED TRIBUTARIES,
Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2E.
W89-08879

FLOOD FORECASTING MODEL FOR CITANDUY RIVER BASIN,
Uttar Pradesh Irrigation Research Inst. Roorkee (India).
For primary bibliographic entry see Field 2E.
W89-08880

UNCERTAINTY AND CONFIDENCE IN ESTIMATING FLOOD FREQUENCIES FROM HURRICANES AND NORTHEASTERS AT UNGAGED COAST LOCATIONS: A NEW METHODOLOGY,
For primary bibliographic entry see Field 2E.
W89-08881

STAGE-FREQUENCY CURVES FOR FLOODING DUE TO WAVE OVERTOPPING OF SEAWALLS,
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2E.
W89-08882

ERRORS DUE TO LINEARIZATION IN TIDAL PROPAGATION,
South Florida Water Management District, West Palm Beach.
For primary bibliographic entry see Field 2L.
W89-08885

BED LOAD SAMPLING AND ANALYSIS,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2J.
W89-08938

CONCEPTUAL MODELS OF SEDIMENT TRANSPORT IN STREAMS,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 2J.
W89-08947

INVESTIGATION OF SEDIMENT ROUTING BY SIZE FRACTIONS IN A GRAVEL-BED RIVER,
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W89-08948

TIME-VARYING STOCHASTIC MODEL OF THE FREQUENCY AND MAGNITUDE OF BED LOAD TRANSPORT EVENTS IN TWO SMALL TROUT STREAMS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W89-08963

ESTIMATING THE TRANSPORT AND DEPOSITION OF MINING WASTE AT OK TEDI,
Ok Tedi Mining Ltd., Port Moresby (Papua New Guinea).
For primary bibliographic entry see Field 5B.
W89-08965

SYNTHESIS OF BOREHOLE GEOPHYSICAL DATA AT THE UNDERGROUND RESEARCH LABORATORY, MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W89-08980

SEDIMENT-TRANSPORT CURVES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2J.

W89-08989

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1987,
Geological Survey, Denver, CO. Water Resources Div.
B. R. Lewelling.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-683, 1987. 1p, 2 fig, 1 map, 2 ref.

Descriptors: *Potentiometric level, *Floridan Aquifer, *Maps *Florida, *Groundwater level, Hydrologic data collections, Groundwater management, Seasonal variation.

The potentiometric surface in the Upper Floridan aquifer was mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours that connect points of equal altitude. Maps of the potentiometric surface of the Upper Floridan aquifer in west-central Florida are prepared semiannually by the U.S. Geological Survey. Maps for May and September show, respectively, the potentiometric surface of the normally expected annual low and high water level conditions. Potentiometric surface maps have been prepared for January 1964, May 1969, May 1971 to 1974, and for each May and September since 1975. The potentiometric surface of the Upper Floridan aquifer is shown for September 1987. Most of the water level data were collected by the U.S. Geological Survey during the period of September 14-18. Supplemental data were collected by other agencies and companies. This map represents water level conditions near the end of the summer rainy season when groundwater withdrawals for agricultural use are low and therefore, when the potentiometric surface is near its highest level for the year. (See also W88-03126) (Lantz-PTT)
W89-09000

PRELIMINARY WATER-USE ESTIMATES IN THE UND STATES IN 1985,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-09002

POTENTIOMETRIC SURFACE OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, MAY 1987,
Geological Survey, Denver, CO. Water Resources Div.
B. R. Lewelling.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-705, 1988. 1(map)p, 6 fig, 3 ref.

Descriptors: *Potentiometric level, *Aquifer systems, *Florida, *Maps, *Groundwater level, Aquifers, Well yields, Groundwater budget, Geohydrology, Hydrologic data.

The intermediate aquifer system within the Southwest Florida Water Management District underlies a 5,000 sq mi area of De Soto, Sarasota, Hardee, Manatee, and parts of Charlotte, Hillsborough, Highlands, and Polk Counties. The intermediate aquifer system occurs between the overlying surficial aquifer system and the underlying Floridan aquifer system, and consists of layers of sand, shell, clay, marl, limestone, and dolom of the Tamiami, Hawthorn, and Tampa Formations of late Tertiary age. The intermediate aquifer system contains one or more water-bearing units separated by discontinuous confining units. This aquifer system is the principal source of potable water in the southwestern part of the study area and is widely used as a source of water in other parts where wells are open to the intermediate aquifer system or to both the intermediate and Floridan aquifer systems. Yields of individual wells open to the intermediate aquifer system range from a few gallons to several hundred gallons per minute. The volume of water withdrawn from the intermediate aquifer system is considerably less than that withdrawn from the Floridan aquifer system in the study area. The surface was mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours that connect points of equal altitude. The compos potentiometric surface of all water-bearing units within the intermediate aquifer system is shown. In areas where multiple aquifers exist, wells open to all aquifers were selected for water level measurements whenever possible. In the southwestern and lower coastal region of the study area, two aquifers and confining units are described for the intermediate aquifer system: the Tamiami-upper Hawthorn aquifer and the underlying lower Hawthorn-upper Tampa aquifer. The potentiometric surface of the Tamiami-upper Hawthorn aquifer is also shown. Water levels are from wells drilled and open exclusively to that aquifer. The exact boundary for the Tamiami-upper Hawthorn aquifer is undetermined because of limd geohydrologic data available from wells. (Lantz-PTT)
W89-09003

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN EAST CARSON VALLEY, DOUGLAS COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09004

SIMULATED CHANGES IN GROUND-WATER FLOW CAUSED BY HYPOTHETICAL PUMPING IN SOUTHEASTERN CARSON CITY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09005

PREPROCESSOR AND POSTPROCESSOR COMPUTER PROGRAMS FOR A RADIAL-FLOW, FINITE-ELEMENT MODEL,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09007

INTERACTIVE PROGRAM TO DISPLAY USER-GENERATED OR FILE-BASED MAPS ON A PERSONAL COMPUTER MONITOR,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09009

PRINCIPLE OF SUPERPOSITION AND ITS APPLICATION IN GROUND-WATER HYDRAULICS,
T. E. Reilly, O. L. Franke, and G. D. Bennett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Techniques of Water-Resources Investigations Book 3: Applications of Hydraulics, Chapter B6, 1987. 28p, 8 fig, 4 worksheets, 7 ref, 3 append. Also available as USGS Open-File Report 84-459, (1984). 36p, 8 fig, 4 worksheets, 7 ref, 3 append.

Descriptors: *Hydraulics, *Groundwater, *Geohydrology, *Pressure head, *Superposition, *Groundwater movement, *Data interpretation, Mathematical studies, Hydraulic systems, Boundary conditions, Differential equations, Drawdown, Impervious boundaries.

The principle of superposition, a powerful mathematical technique for analyzing certain types of complex problems in many areas of science and technology, has important applications in groundwater hydraulics and modeling of groundwater systems. Superposition embodies the concept that problem solutions can be added together to obtain new solutions, provided the system under consideration is linear (that is, governed by linear differential equations and boundary conditions). When superposition is used to solve groundwater problems, studies deal in terms of changes in head (drawdowns) and changes in flows rather than absolute values of heads and flows. These changes are usually calculated from initial conditions of zero change in head everywhere (zero drawdown). When superposition is used in a boundary-value problem (which includes all problems in groundwater flow), it is customary to set constant head boundaries to zero (representing zero change in head) and to represent specified-flux boundaries as impermeable or no-flow boundaries (zero change in flow). Superposition also allows investigation of the effects of stresses on the groundwater system in isolation from other acting stresses. (See also W86-03040) (Lantz-PTT)
W89-09011

MODULAR THREE-DIMENSIONAL FINITE-DIFFERENCE GROUND-WATER FLOW MODEL,
For primary bibliographic entry see Field 2F.
W89-09015

GEOHYDROLOGIC FRAMEWORK OF THE COASTAL PLAIN AQUIFERS OF SOUTH CAROLINA,
Geological Survey, Columbia, SC. Water Resources Div.
W. R. Aucott, M. E. Davis, and G. K. Speiran.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4271, 1987. 7p(maps), 16 fig, 1 tab, 46 ref.

Descriptors: *Regional Aquifer System Analysis Program, *Geohydrology, Coastal aquifers, *South Carolina, *Groundwater movement, *Aquifer systems, *Maps, Hydrologic data collections, Groundwater budget, Aquifers.

The U.S. Geological Survey is conducting a series of investigations of aquifers throughout the United States as a part of the RASA (Regional Aquifer System Analysis) program. These investigations provide a comprehensive regional understanding of groundwater resources throughout the Nation. The Coastal Plain aquifers in South Carolina are being studied as a part of this program. An important part of a description of the groundwater resources is the development of a geohydrologic framework. Such a framework delineates the aquifers through which groundwater flows and the confining units which retard the flow of groundwater between aquifers. The Coastal Plain of South Carolina is underlain by a wedge of sediments that thickens from its inner margin, the Fall Line, to the coast and consists of sand, silt, clay, and limestone of Late Cretaceous to Holocene age. These sediments are underlain by pre-Cretaceous rocks consisting of consolidated sedimentary rocks of Triassic age and a complex of metamorphic and igneous rocks similar to those found near the surface in the Piedmont province of the State. The geohydrologic framework that divides the sediments of the South Carolina Coastal Plain into the Coastal Plain aquifer system is delineated by eleven geohydrologic sections and four maps showing the configuration of the top or base of individual aquifers. Although flow within the Coastal Plain aquifer system is three dimensional, simplifying the system by dividing it into a framework of discrete hydrologic units can aid significantly in understanding the hydrology of the system. This framework is the basis for the aquifers used in potentiometric mapping, transmissivity mapping, geochemical analysis, and groundwater flow modeling for the South Carolina RASA program. (Lantz-PTT)
W89-09016

POTENTIOMETRIC-SURFACE MAP OF THE WYODAK-ANDERSON COAL BED, POWDER RIVER STRUCTURAL BASIN, WYOMING, 1973-84,
Geological Survey, Cheyenne, WY. Water Resources Div.
P. B. Daddow.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4305, 1986.

1p(map), 2 fig, 1 tab, 1 map.

Descriptors: *Wyoming, *Geohydrology, *Groundwater level, *Potentiometric level, *Maps, *Powder River Basin, Hydrologic data collections, Stratigraphy, Aquifers.

Previous water level maps of shallow aquifers in the Powder River structural basin in Wyoming were based on water levels from wells completed in different stratigraphic intervals within thick sequences of sedimentary rocks. A potentiometric surface using water levels from a single aquifer had never been mapped throughout the basin. The sandstone aquifers in the Fort Union Formation of Paleocene age and the Wasatch Formation of Eocene age are discontinuous and lenticular, and do not extend even short distances. Coal aquifers are more continuous and the Wyodak-Anderson coal bed, in the Fort Union Formation, has been mapped in much of the Powder River structural basin in Wyoming. Water level altitudes in the Wyodak-Anderson coal bed and other stratigraphically equivalent coal beds were mapped to determine if they represent a continuous potentiometric surface in the Powder River structural basin. The potentiometric surface, except in the vicinity of the Wyodak mine east of Gillette, represents a premining condition as it was based on water level measurements made during 1973-84 that were not significantly affected by mining. The map was prepared in cooperation with the U.S. Bureau of Land Management. (Lantz-PTT)
W89-09017

QUALITY OF GROUND WATER IN THE COLUMBIA BASIN, WASHINGTON, 1983,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09025

PHYSICAL CHARACTERISTICS AND CHEMICAL QUALITY OF SELECTED SPRINGS IN PARTS OF JUAB, MILLARD, TOOELE, AND UTAH COUNTIES, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09028

GROUND-WATER LEVELS AND DIRECTION OF GROUND-WATER FLOW IN THE CENTRAL PART OF BERNALILLO COUNTY, NEW MEXICO, SUMMER 1983,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09029

ANALYSES OF FLOOD-FLOW FREQUENCY FOR SELECTED GAGING STATIONS IN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09037

STREAMFLOW STATISTICS AND DRAINAGE-BASIN CHARACTERISTICS FOR THE PUGET SOUND REGION, WASHINGTON, VOLUME I: WESTERN AND SOUTHERN PUGET SOUND,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09044

STREAMFLOW STATISTICS AND DRAINAGE-BASIN CHARACTERISTICS FOR THE PUGET SOUND REGION, WASHINGTON, VOLUME II: EASTERN PUGET SOUND FROM SEATTLE TO THE CANADIAN BORDER,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09045

HYDROLOGIC DATA ON THE PUEBLOS OF JEMEZ, ZIA, AND SANTA ANA, SANDOVAL COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09051

DIGITAL MODELING OF SOLUTE TRANSPORT IN A PLUME OF SEWAGE-CONTAMINATED GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09054

PRINCIPAL FACTS FOR GRAVITY STATIONS IN DIXIE, FAIRVIEW, AND STINGAREE VALLEYS, CHURCHILL AND PERSHING COUNTIES, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer, J. M. Thomas, and B. G. Duffrin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-586, 1984. 15p, 2 ref.

Descriptors: *Geophysics, *Data collections, *Gravity data, *Geophysical data, *Gravity studies, *Data collections, *Nevada, Groundwater, Geohydrology, Bedrock.

During March through July 1979, gravity measurements were made at 300 stations in Dixie Valley, Nevada. In December 1981, 45 additional stations were added--7 in Dixie Valley, 23 in Fairview Valley, and 15 in Stingaree Valley. Most altitudes were determined by using altimeters or topographic maps. The gravity observations were made with a Worden temperature-controlled gravimeter with an initial scale factor of 0.0965 milliGal/scale division. Principal facts for each of the 345 stations are tabulated; they consist of latitude, longitude, altitude, observed gravity, free-air anomaly, terrain correction, and Bouguer anomaly values at a bedrock density of 2.67 grams/cu cm. (Lantz-PTT)
W89-09061

HYDROLOGIC AND CLIMATOLOGIC DATA FOR THE LEHIGH AREA, SOUTHEASTERN OKLAHOMA, MAY 1977 TO JANUARY 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
S. P. Blumer, and J. C. Scott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 84-599, 1984. 212p, 12 fig, 37 tab, 14 ref.

Descriptors: *Hydrologic data collections, *Climatic data, *Water quality *Oklahoma, Coal mining, Environmental effects, Streamflow, Suspended sediments, Dissolved oxygen, Hydrogen ion concentration, Specific conductivity, Water quality, Stream discharge, Soil water, Groundwater level, Water level, Wells, Chemical analysis.

Hydrologic and climatologic data were collected in the Lehigh area in southeastern Oklahoma during an investigation of the hydrologic effects of coal strip mining. The purpose of the study was to assess the probable effects of surface mining for coal and subsequent reclamation on the hydrologic characteristics of the basin. Data collected between 1977 and 1982 is presented, including: (1) > four yr of daily and selected unit streamflow, daily suspended sediment discharge, analyses of periodic samples for chemical quality, and daily temperature, pH, specific conductance, and dissolved oxygen at the Coal Creek near Lehigh gaging station; (2) partial record discharge data and analyses of periodic samples for chemical quality and sediment for two tributaries of Coal Creek; (3) climatologic data for four sites; (4) soil moisture at 13 measurement sites; (5) continuous record of the water level in one well; (6) periodic record of water level in a second well; (7) water level records for 43 wells and springs including on-site measurement of physical parameters; and (8) complete chemical analyses of water samples from eleven wells and one spring. (Author's abstract)
W89-09062

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN MONTANA,
M. E. Cooley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-936, 1983. 2p(maps), 7 ref.

Descriptors: *Maps, *Satellite technology, *Topography, *Montana, Vegetation, Soil properties, Aquifers, Landstat.

This map is one of a series of linear features maps compiled for the U.S. Geological Survey's Northern Great Plains Regional Aquifer System Analysis. This map shows the linear features that were recognized in Montana. Linear features occur on the Earth's surface as straight or slightly curved lines. These features often are referred to as linear trends or lineaments, some of which extend across Montana. The linear features were determined from visual inspection of color-infrared composites of Landsat imagery at a scale of 1:500,000. Physiographic features and tonal differences in vegetation and soils observed on the imagery were used to identify the linear features which were plotted as dashed lines on transparent overlays on the Landsat images only in the locations where they were observed. The major and subordinate linear features were classified according to length into the four groups shown on the map. Determination of the length of the linear features that extend beyond Montana was aided by plotting the linear features from a mosaic of Landsat imagery of the United States compiled by the U.S. Soil Conservation Service. (Lantz-PTT)
W89-09065

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1983,
Geological Survey, Denver, CO. Water Resources Div.
G. L. Barr, and G. R. Schiner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-868, (1983). 1p(map), 1 fig, 2 ref.

Descriptors: *Florida, *Potentiometric level, *Floridan Aquifer, *Groundwater budget, *Maps, Groundwater level, Aquifers, Water level, Groundwater irrigation, Fluctuations, Agricultural, Seasonal variations.

Maps of the potentiometric surface of the Floridan aquifer in west-central Florida are prepared semiannually by the U.S. Geological Survey in cooperation with the Southwest Florida Water Management District. Maps for May and September show the potentiometric surface that is close to the annual low or high water level condition that usually occurs in May or September, respectively. The surface is mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours that connect points of equal altitude. This report shows the potentiometric surface of the Floridan aquifer for September 1983. Data for the map were collected during September 12-23. The map represents water level conditions near the end of the summer rainy season when groundwater withdrawals for agricultural use are low. Water levels in most wells measured in September 1983 were higher than those measured in May 1983. September water levels averaged about 0.6 ft higher than May levels in areas north of Hillsborough County and about 7 ft higher in southern areas. Water level increases in the north ranged from zero to about 2 ft along coastal regions and from zero to about 5 ft in inland areas. Water level declines in the north ranged from zero to about 7 ft and occurred in scattered parts of all northern counties. In the south, water level increases ranged from zero to about 3 ft along coastal and extreme southern regions and from about 5 to 34 ft in other southern

areas. The greatest water level increases occurred in southern Hillsborough County where irrigation pumpage contributes to large seasonal fluctuations. There were a few areas in Hillsborough and Pinellas Counties where September water levels showed declines ranging from about 1 to 3 ft when compared with May levels. (Lantz-PTT)
W89-09071

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1983,
Geological Survey, Denver, CO. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 83-869, 1983. 1p(map).

Descriptors: *Florida, *Potentiometric level, *Floridan Aquifer, *Maps, *Hydrologic maps, *St Johns River, Wells, Springs, Water management.

This potentiometric map highlights: the altitude at which water level would stay in tightly cased wells; wells; springs; state water management district boundaries and sub-basin boundaries. (Lantz-PTT)
W89-09072

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09073

HYDROLOGIC DATA FOR THE GREAT AND DENBOW HEATHS IN EASTERN MAINE, OCTOBER 1981 THROUGH OCTOBER 1982,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09074

REPORT OF THE U.S. GEOLOGICAL SURVEY'S ANALYTICAL EVALUATION PROGRAM--STANDARD REFERENCE WATER SAMPLES M-82 (MAJOR CONSTITUENTS), T-83 (TRACE CONSTITUENTS), N-8 (NUTRIENTS), AND P-2 (PRECIPITATION SNOWMELT),
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09075

GEOHYDROLOGIC DATA FOR TEST WELL UE-25B NUMBER 1, NEVADA TEST SITE, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09083

GEOHYDROLOGIC DATA FOR TEST WELL USW H-6 YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09084

DRAINAGE AREAS IN THE BIG SIOUX RIVER BASIN IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
F. D. Amundson, W. Bradford, and N. C. Koch.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-348, 1985. 1p(map), 3 tab.

Descriptors: *Big Sioux River, *Drainage area, *South Dakota, *Maps, Surface water, Groundwater budget, Hydrologic budget, Aquifers, Hydrologic data, Surface-groundwater relations.

The Big Sioux River basin of eastern South Dakota contains an important surface water supply and a sizeable aquifer system of major importance to the economy of South Dakota. The aquifers are complex, consisting of many small aquifers that are hydrologically associated with several large aquifers and the Big Sioux River. The complexity and interrelation of the surface water/groundwater systems has already created management problems. As development continues and increases, the problems will increase in number and complexity. To aid in planning for future development, an accurate determination of drainage areas for all basins, subbasins, and noncontributing areas in the Big Sioux River basin is needed. All named stream basins, and all unnamed basins > 10 sq mi within the Big Sioux River basin in South Dakota are shown and are listed by stream name. Stream drainage basins in South Dakota were delineated by visual interpretation of contour information shown on U.S. Geological Survey 77-1/2 minute topographic maps. One table lists the drainage areas of major drainage basins in the Big Sioux River basin that do not have a total drainage area value > 10 sq mi. Another shows the drainage area above stream gaging stations in the Big Sioux River basin. (Lantz-PTT)
W89-09092

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, SEPTEMBER 1985,
Geological Survey, Denver, CO. Water Resources Div.
G. L. Barr.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-679, 1985. 1p(map), 2 fig, 2 ref.

Descriptors: *Potentiometric level, *Floridan Aquifer, *Maps, *Florida, Hydrologic maps, Groundwater level, Aquifers, Groundwater budget, Water level.

The potentiometric surface is the level to which water will rise in tightly cased wells that tap the Upper Floridan aquifer. The surface is mapped by determining the altitude of water levels in a network of wells and is represented on maps by contours that connect points of equal altitude. Maps of the potentiometric surface of the Upper Floridan aquifer in west-central Florida are prepared semiannually by the U.S. Geological Survey in cooperation with the Southwest Florida Water Management District. Maps for May and September show, respectively, the potentiometric surfaces of the normally expected annual low and high water level conditions. The potentiometric surface of the Upper Floridan aquifer is shown for September 1985. Most of the water level data were collected during September 9-13. Supplemental data were collected by other agencies and companies. The map represents water level conditions near the end of the summer rainy season when groundwater withdrawals for agricultural use are low. Hence, the potentiometric surface is near its highest level for the year. (Lantz-PTT)
W89-09104

ANALYSIS OF SURFACE-WATER DATA NETWORK IN KANSAS FOR EFFECTIVENESS IN PROVIDING REGIONAL STREAMFLOW INFORMATION--WITH A SECTION ON THEORY AND APPLICATION OF GENERALIZED LEAST SQUARES,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-09105

EVAPOTRANSPIRATION ESTIMATES USING REMOTE-SENSING DATA, PARKER AND PALO VERDE VALLEYS, ARIZONA AND CALIFORNIA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2D.
W89-09110

CONCEPTUAL DESIGN FOR THE NATIONAL WATER INFORMATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10D.
W89-09111

HYDROLOGIC MONITORING IN THE AREA OF THE TENNESSEE-TOMBIGBEE WATERWAY, MISSISSIPPI-ALABAMA FISCAL YEAR 1985,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09121

SEDIMENT DATA FOR COMPUTATIONS OF DEPOSITION RATES IN THE TIDAL POTOMAC SYSTEM, MARYLAND AND VIRGINIA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09128

METHOD FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF UNGAGED STREAMS IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09129

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1984 TO SPRING 1985.
Geological Survey, Tucson, AZ. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-422W, 1986. 2p, 4 fig, 1 tab, 1 map, 26 ref.

Descriptors: *Groundwater budget, *Arizona, *Hydrologic data collections, *Maps, *Groundwater level, *Groundwater quality, Monitoring, Geohydrology, Wells, Chemical analysis, Water level.

In arid and semiarid regions such as Arizona, the availability of adequate water supplies has a significant influence on the type and extent of economic development. About two-thirds of the water used in the State is groundwater. The nature and extent of the groundwater reservoirs must be known for proper management of this valuable resource. The U.S. Geological Survey, in cooperation with the State of Arizona, has conducted a program of groundwater studies in Arizona since 1939. The primary purposes of these studies are to define the amount, location, and quality of the groundwater resources of Arizona and to monitor the effects of large-scale development of the groundwater supplies. The program includes the collection, compilation, and analysis of the geologic and hydrologic data necessary to evaluate the groundwater resources of the State. The basic hydrologic data are in computer storage and are available to the public. Since 1974, a major thrust of the program has been to inventory the groundwater conditions in the 68 groundwater areas of the State. Several selected groundwater areas are studied each year; water levels are measured annually in a statewide observation well network, many groundwater samples are collected and analyzed annually, and groundwater pumpage is computed for most of the areas. As of July 1985, reports had been published for 56 of the 68 groundwater areas. Data collected in the groundwater areas include information on selected wells, water level measurements, and water samples for chemical analysis. The data for each of the selected groundwater areas are analyzed, and the results are published in map form. Typically, the maps show depth to water; change in water levels; altitude of the water level; and quality of water

data, such as specific conductance, dissolved solids, and fluoride. (Lantz-PTT)
W89-09133

FLOOD OF APRIL 5-7, 1984, IN NORTHEASTERN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09134

METHODS AND COMPUTER PROGRAM DOCUMENTATION FOR DETERMINING ANISOTROPIC TRANSMISSIVITY TENSOR COMPONENTS OF TWO-DIMENSIONAL GROUND-WATER FLOW,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09137

SELECTED HYDROLOGIC DATA FROM WELLS IN THE EAST SHORE AREA OF THE GREAT SALT LAKE, UTAH, 1985,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09139

SIMULATION OF FIVE GROUND-WATER WITHDRAWAL PROJECTIONS FOR THE BLACK MESA AREA, NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09141

SIMULATION OF THREE LAHARS IN THE MOUNT ST. HELENS AREA, WASHINGTON USING A ONE-DIMENSIONAL, UNSTEADY-STATE STREAMFLOW MODEL,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2J.
W89-09143

AVAILABILITY OF GROUND WATER IN THE UNCONSOLIDATED AQUIFERS IN THE MID-HUDSON RIVER BASIN, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
E. F. Bugliosi.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4028, 1987. 1p(map).ref.

Descriptors: *Water resources data, *Goundwater budget, *Aquifers, *Hydrologic maps, *Hudson River, *New York, Maps, Wells, Well yield.

Protection of New York State's aquifers has become an increasingly important issue among water resource managers at all levels of State and municipal government. Aquifer delineation is necessary as an initial phase in the effective management of the State's groundwater resources. As part of an effort to delineate all major unconsolidated aquifers in New York, a cooperative study was conducted to compile a groundwater availability map that would complete the reconnaissance mapping of the mid-Hudson River basin at a scale of 1:250,000. This map delineates the principal unconsolidated aquifers in the mid-Hudson River basin area and the estimated potential yield of properly constructed wells completed in these aquifers. (Lantz-PTT)
W89-09149

MAP SHOWING OCCURRENCES OF SPRING-DEPOSITED TRAVERTINE IN THE CONTERMINOUS WESTERN UNITED STATES,
Geological Survey, Menlo Park, CA.
J. H. Feth, and I. Barnes.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 79-35, Open File Report, 1979. 1p, 2 fig, 1 map, 126 ref.

Descriptors: *Paleohydrology, *Travertine, *Geology, *Springs, *Maps, Carbonates, Minerals, Calcium carbonate, Geologic fractures, Idaho, California, Nevada, Utah, Geochemistry.

Extinct travertine terraces occur hundreds of meters above present levels of spring activity and have potentials for interpretation of ancient hydrologic systems, rates of downcutting, or rates of tectonic uplift that remain virtually unexploited. The abundance and size of extinct travertine deposits suggest that in many places, such as pinnacles at the southwest end of the Searles Lake basin, California, spring activity was once more widespread and copious than it is now. Travertine of Eocene age has been reported, and a scattering of later Tertiary occurrences is known. But where age has been inferred, the inferred ages are predominantly Pleistocene or younger. So travertine seems to be a geologically transient phenomenon, subject either to removal by erosion or to burial and disappearance. Many travertine deposits are known to be on or close to faults. Their occurrence in otherwise structurally featureless alluvial valleys may, therefore, suggest the possibility of a hidden fault. From the Front Range to the Pacific, more than 300 travertime deposits have been identified. The map shows that the deposits are widely dispersed. However, there are apparent groupings on the Wasatch Fault and associated tectonic areas trending northward in Utah and southern Idaho, and also near the great fault zone that marks the eastern boundary of the Sierra Nevada, California. (Lantz-PTT)
W89-09150

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map LN-25, (1982). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Lea County, Groundwater level, Groundwater budget, Groundwater management Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Northern Lea County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09151

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map LC-25, (1982). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Lea County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in central Lea County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09152

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map CU-23, (1982). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Curry County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Curry County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09153

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1982,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map RO-26, (1982). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Roosevelt County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Roosevelt County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09154

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN PORTALES VALLEY, ROOSEVELT COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map RO-29, (1985). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Roosevelt County, Groundwater level, Groundwater budget, Groundwater management, Texas.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Roosevelt County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county. (Lantz-PTT)
W89-09155

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN CENTRAL LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map LC-28, (1985). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Lea County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Central Lea County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09156

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE, FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map CU-26, (1985). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Curry County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Curry County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09157

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN NORTHERN LEA COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE FOR CALENDAR YEAR 1985,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map LN-28, (1985). 1p(map).

Descriptors: *Groundwater depletion, *Maps, *New Mexico, Lea County, Groundwater level, Groundwater budget, Groundwater management, Texas.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in northern Lea County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09158

GROUND-WATER DEPLETION, IN FEET, ALLOWED IN A PART OF CURRY COUNTY, NEW MEXICO, BY U.S. INTERNAL REVENUE SERVICE, FOR CALENDAR YEAR 1986,
New Mexico State Engineer Office, Santa Fe.
J. D. Hudson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. New Mexico State Engineer Map CU-27, (1986). 1p(map).

Descriptors: *Groundwater depletion, *Maps, New Mexico, Curry County, Groundwater level, Groundwater budget, Groundwater management, Taxes.

The map illustrates the areas of unsaturated, post-mesozoic deposits, in Curry County, New Mexico (as of January 1962), as well as groundwater depletion allowed in the county for tax purposes by the IRS. (Lantz-PTT)
W89-09159

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1986,
Geological Survey, Reston, VA.
L. A. Bradner.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-412W, 1986. 1p(map).

Descriptors: *Potentiometric level, *Groundwater budget, *Maps, *Floridan Aquifer, *Florida, Groundwater level, Water level, Aquifers, Wells, Springs.

Potentiometric contours illustrate the altitude at which water levels would stay consistent in tightly cased wells. Springs and wells are also highlighted on this map of the Upper Floridan aquifer in central Sumter County, Florida. (Lantz-PTT)
W89-09160

PRELIMINARY MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1984,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4338, (1985). 1p(map).

Descriptors: *Potentiometric level, *Aquia Aquifer, *Groundwater budget, *Maps, *Hydrologic maps, Well yield, Maryland, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Aquia aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09161

PRELIMINARY MAP SHOWING THE DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE AQUIA AQUIFER OF SEPTEMBER 1982 AND SEPTEMBER 1984 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4339, (1985). 1p(map).

Descriptors: *Potentiometric level, *Aquia Aquifer, *Groundwater budget, *Maps, *Hydrologic maps, Well yield, Maryland, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Aquia aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09162

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER OF SEPTEMBER 1982 AND SEPTEMBER 1984 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4337, (1985). 1p(map).

Descriptors: *Potentiometric level, *Magothy Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Water yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Magothy aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09163

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1984,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4203, (1985). 1p(map).

Descriptors: *Potentiometric level, *Magothy Aquifer, *Groundwater budget, *Maps, *Hydrologic maps, *Maryland, Well yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Magothy aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09164

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER, 1985,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4025, (1987). 1p(map).

Descriptors: *Potentiometric level, *Magothy Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Magothy aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09165

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND, SEPTEMBER 1985,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4029, (1987). 1p(map).

Descriptors: *Potentiometric level, *Aquia Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Aquia aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09166

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1986,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, S. E. Curtin, and D. C. Andreasen.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4214, (1987). 1p(map).

Descriptors: *Potentiometric level, *Aquia Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells.

Thr potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Aquia aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09167

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE AQUIA AQUIFER IN SPRING OF 1979 AND FALL OF 1986 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4215, (1987). 1p(map).

Descriptors: *Potentiometric level, *Aquia Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Aquia aquifer; (2) the approximate line of equal distance between the potentiometric surfaces of spring 1979 and fall 1986; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09168

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING FALL OF 1986,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4216, (1987). 1p(map).

Descriptors: *Potentiometric level, *Magothy Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells, Hydrologic maps.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Magothy aquifer; (2) the potentiometric contour of the aquifer; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09169

DIFFERENCE BETWEEN THE POTENTIOMETRIC SURFACES OF THE MAGOTHY AQUIFER IN FALL OF 1975 AND FALL OF 1986 IN SOUTHERN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4217, (1987). 1p(map).

Descriptors: *Potentiometric level, *Magothy Aquifer, *Groundwater budget, *Maps, *Maryland, *Hydrologic maps, Well yield, Groundwater level, Observation wells, Wells.

The potentiometric map is highlighted with indications concerning: (1) outcrop areas of the Magothy aquifer; (2) the approximate location of the line of equal difference between the potentiometric surface in fall 1975 and fall 1986; (3) observation and/or supply wells yielding < 10,000 gallons/day (gpd); and (4) other supply wells with yields > 10,000 gpd. (Lantz-PTT)
W89-09170

POTENTIOMETRIC SURFACE OF THE BISCAYNE AQUIFER NORTHWEST WELL FIELD DADE COUNTY, FLORIDA, MAY 24, 1984,
Geological Survey, Miami, FL. Water Resources Div.
H. Klein.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 86-60, (1986). 1p(map).

Descriptors: *Hydrologic maps, *Florida, *Maps, *Potentiometric level, *Biscayne Aquifer, Wells, Dade County, Geohydrology, Groundwater budget, Groundwater level.

The potentiometric contours of the study area are generalized at a pumping rate of 130 mil gal/day, May 19-24, 1984 to portray synoptically the head in a dynamic hydrologic system taking due account of the variations in geohydrologic conditions such as differing depths of wells, nonsimultaneous measurements of water levels, variable effects of pumping, regulations of canal levels, and changing climatic influence. Therefore, potentiometric contours may not conform exactly with individual measurements of water level. The area mapped is between the Miami Canal, the Tamiami Canal, and the Level 30 Canal. (Lantz-PTT)
W89-09171

POTENTIOMETRIC SURFACE OF THE BISCAYNE AQUIFER NORTHWEST WELL FIELD DADE COUNTY, FLORIDA, OCTOBER 16, 1984,
Geological Survey, Miami, FL. Water Resources Div.
H. Klein.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Open File Report 86-59, 1985. 1p(map).

Descriptors: *Hydrologic maps, *Maps, *Potentiometric level, *Florida, *Biscayne Aquifer, Wells, Dade County, Geohydrology, Groundwater budget, Groundwater level.

The potentiometric contours of the study area are generalized at a pumping rate of 70 mil gal/day, Oct. 10-16, 1984 to portray synoptically the head in a dynamic hydrologic system taking due account of the variations in geohydrologic conditions such as differing depths of wells, nonsimultaneous measurements of water levels, variable effects of pumping, regulations of canal levels, and changing climatic influence. Therefore, the potentiometric contours may not conform exactly with individual measurements of water level. (Lantz-PTT)
W89-09172

GROUND-WATER HYDROLOGY OF THE MINOR TRIBUTARY BASINS OF THE OHIO RIVER, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09173

GROUND-WATER HYDROLOGY OF THE MINOR TRIBUTARY BASINS OF THE KANAWHA RIVER, WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
G. M. Ferrell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. 1984. 1p, 9 fig, 7 tab, 28 ref.

Descriptors: *Groundwater budget, *Groundwater quality, *Maps, *Hydrologic data collections, *Kanawha River, *Hydrologic maps, *West Virginia, Geohydrology, Chemical analysis, Well yield, Saline water.

One of a series of hydrologic atlases that summarize the availability and quality of the groundwater resources of the major river basins in West Virginia is presented. These atlases were designed to aid the West Virginia Department of Natural Resources in delineating sources of potable groundwater that need protection under U.S. EPA's Underground Injection Control Program regulations. The study area consists of the Lower New River drainage basin from Hinton to Gauley Bridge, and the Kanawha River drainage basin from Gauley Bridge to Point Pleasant. The Gauley, Elk, and Coal River drainage basins are not included in the study area. The 2,135 sq mi area is elongated roughly from southeast to northwest. Most of the land is forested; other major land uses include agriculture, coal mining, and residential and industrial development. Highlights of this atlas include: water bearing potential; chemical quality of the groundwater; general hydrology of mined and unmined areas; groundwater availability; well yields; and salty water. (Lantz-PTT)
W89-09174

AQMAN: LINEAR AND QUADRATIC PROGRAMMING MATRIX GENERATOR USING TWO-DIMENSIONAL GROUND-WATER FLOW SIMULATION FOR AQUIFER MANAGEMENT MODELING,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09183

SIMULATED EFFECTS OF GROUND-WATER MANAGEMENT ALTERNATIVES FOR THE SALINAS VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W89-09186

CHANGES IN WATER QUALITY OF MICHIGAN STREAMS NEAR URBAN AREAS, 1973-84,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-09193

POTENTIAL WELL YIELDS FROM UNCONSOLIDATED DEPOSITS IN THE LOWER HUDSON AND DELAWARE RIVER BASINS, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 87-4042, 1987. 1p(map), 18 ref.

Descriptors: *Water resources data, *New York, *Well yield, *Groundwater budget, *Hydrologic maps, *Maps, *Aquifers, Hudson River, Delaware River, Geohydrology.

A comprehensive groundwater protection plan, developed by the New York State Department of Environmental Conservation in 1985, identified the need to delineate significant aquifers within the state. A map of the unconsolidated aquifers in the lower Hudson and Delaware River basins was compiled from available data on the surficial geology and well yields. It delineates the significant unconsolidated aquifers and indicates the potential yield of wells that tap these aquifers. The potential well yield is categorized into three ranges: < 10 gal/min; 10 to 100 gal/min; and > 100 gal/min. No yield range is given for till, but some large diameter or dug wells in till may yield up 10 gal/min. (Lantz-PTT)
W89-09195

LARGEST RIVERS IN THE UNITED STATES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09208

DISTRIBUTED INFORMATION SYSTEM,
Geological Survey, Reston, VA.
A. W. Harbaugh.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-649, 1986. 2p, 1 fig.

Descriptors: *Information exchange, *Networks, *Computers, *Data storage and retrieval, Hydro-

logic data, Administration, Distributed information system.

During 1982-85, the Water Resources Division (WRD) of the U.S. Geological Survey (USGS) installed over 70 large minicomputers in offices across the country to support its mission in the science of hydrology. These computers are connected by a communications network that allows information to be shared among computers in each office. The computers and network together are known as the Distributed Information System (DIS). The computers are accessed through the use of more than 1500 terminals and minicomputers. The WRD has three fundamentally different needs for computing: data management; hydrologic analysis; and administration. Data management accounts for 50% of the computational workload of WRD because hydrologic data are collected in all 50 states, Puerto Rico, and the Pacific trust territories. Hydrologic analysis consists of 40% of the computational workload of WRD. Cost accounting, payroll, personnel records, and planning for WRD programs occupies an estimated 10% of the computer workload. The DIS communications network is shown on a map. (Lantz-PTT)
W89-09212

GEOHYDROLOGY AND NUMERICAL SIMULATION OF THE ALLUVIUM AND TERRACE AQUIFER ALONG THE BEAVER-NORTH CANADIAN RIVER FROM THE PANHANDLE TO CANTON LAKE, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09215

APPLICATION OF GAUSS ALGORITHM AND MONTE CARLO SIMULATION TO THE IDENTIFICATION OF AQUIFER PARAMETERS,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09216

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME 2: GENERAL INFORMATION AND STATION LIST FOR THE ISLANDS OF OAHU, MOLOKAI, MAUI, AND HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09217

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME 3: STATION LOCATION MAPS FOR THE ISLANDS OF OAHU, MOLOKAI, MAUI AND HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
I. Matsuoka.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 81-1056-B, 1983. 12p(maps).

Descriptors: *Surface water, *Hawaii, *Maps, *Hydrologic maps, Stream discharge, Water quality, Oahu, Maui, Molokai.

Twelve maps comprise this volume presenting locations of surface water discharge and water quality data sites for: (1) Northern Oahu, 1979; (2) Southern Oahu, 1979; (3) Western Molokai, 1979; (4) Eastern Molokai, 1979; (5) Southeastern Maui, 1979; (6) Northeastern Maui, 1979; (7) Western Maui, 1979; (8) Northeastern Maui, 1979; (9) Eastern Hawaii, 1979; (10) Northwestern Hawaii, 1979; (11) Southwestern Hawaii, 1979; and (12) Northwestern Hawaii, 1979. (See also W89-09217) (Lantz-PTT)
W89-09218

THREE-DIMENSIONAL MATHEMATICAL MODEL FOR SIMULATING THE HYDROLOGIC SYSTEM IN THE PICEANCE BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09222

WATER RESOURCES OF ROCKLAND BASIN, SOUTHEASTERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-09223

SUPPORTING DATA FOR ENVIRONMENTAL TRENDS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W89-09227

CLIMATOLOGICAL DATA FOR THE RICE-GROWING AREAS ALONG THE NORTH COAST OF PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-09228

WATEQ4F--A PERSONAL COMPUTER FORTRAN TRANSLATION OF THE GEOCHEMICAL MODEL WATEQ2 WITH REVISED DATA BASE,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. W. Ball, D. K. Nordstrom, and D. W. Zachmann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-50, 1987. 108p, 2 tab, 26 ref, 2 append.

Descriptors: *FORTRAN, *Model studies, *Computer programs, *Data interpretation, *Computer models, *Water quality, *Geochemistry, Water analysis, Simulation analysis, Model studies, Microcomputers, Trace elements, Documentation.

A FORTRAN 77 version of the PL/1 computer program for the geochemical model WATEQ2, which computes major and trace element speciation and mineral saturation for natural waters has been developed. The code (WATEQ4F) has been adapted to execute on an IBM PC or compatible microcomputer. Two versions of the code are available, one operating with IBM Professional FORTRAN and an 8087 or 89287 numeric coprocessor, and one which operates without a numeric coprocessor using Microsoft FORTRAN 77. The calculation procedure is identical to WATEQ2, which has been installed on many mainframes and minicomputers. Limited data base revisions include the addition of the following ions: AlHS04(++), BaS04, CaHS04(++), FeHS04(++), NaF, SrC03, and SrHCO3(+). This report provides the reactions and references for the data base revisions, instructions for program operation, and an explanation of the input and output files. Attachments contain sample output from three water analyses used as test cases and the complete FORTRAN source listing. U.S. Geological Survey geochemical simulation program PHREEQE and mass balance program BALANCE also have been adapted to execute on an IBM PC or compatible microcomputer with a numeric coprocessor and the IBM Professional FORTRAN compiler. (Author's abstract)
W89-09232

MICROCOMPUTER-BASED VERSION OF SIPT--A PROGRAM FOR THE INTERPRETATION OF SEISMIC-REFRACTION DATA (TEXT),
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09233

MAPS OF RUNOFF IN THE NORTHEASTERN REGION AND THE SOUTHERN BLUE RIDGE PROVINCE OF THE UNITED STATES DURING SELECTED PERIODS IN 1983-85,
Geological Survey, Madison, WI. Water Resources Div.
D. J. Graczyk, W. A. Gebert, W. R. Krug, and G. J. Allord.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open- File Report 87-106, 1987. 8p, 1 fig, 4 tab, 3 plates, 4 ref.

Descriptors: *Hydrologic maps, *Maps, *Runoff, *Annual runoff, Statistical analysis, Hydrologic data collections, Surface runoff, Connecticut, Massachusetts, New Jersey, North Carolina, Tennessee, Maine, New York, Pennsylvania, Virginia.

Maps of annual runoff for two regions in the eastern United States were prepared by the U.S. Geological Survey for the Direct/Delayed Response Project being conducted by the U.S. EPA. These maps show annual runoff during water year 1984 in the northeastern region and in the Southern Blue Ridge Province. Runoff from the northeastern region during the 1984 water yr ranged from 12 to 55 in.; this was 25 to 55% > average runoff for the 1951-80 period. Runoff from the Southern Blue Ridge Province during the 1984 water year ranged from 14 to 60 in.; this was 10 to 30% > the average runoff for the 1951-80 period. A split sample analysis of the data for New York was conducted to evaluate the accuracy of the runoff mapping procedure used in this report. A runoff map was prepared using one-half of the data base. The map was then used to estimate runoff at the gaging stations that were not used to develop the map. The values estimated from the split-sample map were found to differ from the actual recorded values by 9.9%. The runoff maps are most accurate in areas with a relatively large concentration of gaging stations and little topographic variability. Conversely, the maps are least accurate in areas with few gaging stations and high topographic variability. Based on these criteria, those parts of the maps covering Connecticut, Massachusetts, New Jersey, and Rhode Island, are the most reliable. The least reliable parts of the maps are those along the North Carolina-Tennessee border and in parts of Maine. (Author's abstract)
W89-09236

DEVELOPMENT OF A DATA BASE FOR WATER-QUALITY MODELING OF THE PATUXENT RIVER BASIN, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 10A.
W89-09251

TEST PLAN FOR 32-BIT MICROCOMPUTERS FOR THE WATER RESOURCES DIVISION, CHAPTER A: TEST PLAN FOR ACQUISITION OF PROTOTYPE 32-BIT MICROCOMPUTERS,
Geological Survey, Reston, VA. Water Resources Div.
N. E. Hutchison, A. W. Harbaugh, R. A. Hollway, and C. F. Merk.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-455, 1987. 60p, 3 ref, 5 append.

Descriptors: *Microcomputers, *US Geological Survey, *Information systems, *Computers, *Data storage and retrieval, Evaluation, Networks, Management planning.

The Water Resources Division (WRD) of the U.S. Geological Survey is evaluating 32-bit microcomputers to determine how they can complement, and perhaps later replace, the existing network of minicomputers. The WRD is also designing a National Water Information System (NWIS) that will combine and integrate the existing National Water Data Storage and Retrieval System (WATSTORE), National Water Data Exchange (NAWDEX), and components of several other existing systems. The procedures and testing done

in a market evaluation of 32-bit microcomputers are documented. The results of the testing are documented in the NWIS Project Office. The market evaluation was done to identify commercially available hardware and software that could be used for implementing early NWIS prototypes to determine the applicability of 32-bit microcomputers for data base and general computing applications. Three microcomputers will be used for these prototype studies. The results of the prototype studies will be used to compile requirements for a Request for Procurement (RFP) for hardware and software to meet the WRD's needs in the early 1990's. The identification of qualified vendors to provide the prototype hardware and software included reviewing industry literature, and making telephone calls and personal visits to prospective vendors. Those vendors that appeared to meet general requirements were required to run benchmark tests. (Author's abstract)
W89-09263

PRELIMINARY SURFICIAL GEOLOGY MAP OF THE CHEYENNE URBAN AREA, LARAMIE COUNTY, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Cooley.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-559, 1987. 1p(map).

Descriptors: *Maps, *Geologic mapping, *Cheyenne, *Wyoming, Artificial fill, Alluvium, Geology, Stratification, Sediments.

The geologic map of the Cheyenne Urban Area shows the following elements: (1) artificial fill at miscellaneous sites; (2) artificial fill in areas of large residential developments constructed since 1945; (3) artificial fill in areas of extensive construction activity; (4) undifferentiated alluvium (holocene); (5) terrace alluvium (holocene); (6) alluvial fan deposits (holocene); (7) slope deposits (holocene and pleistocene); (8) tan sandy alluvium (pleistocene); (9) pediment deposits (pleistocene); (10) deposits of terrace Qt1 (pleistocene); (11) deposits of terraces Qt1A, Qt1B, Qt1C (pleistocene); (12) Deposits of Qt2 (pleistocene); (13) Deposits of terrace Qt3 (pleistocene); (14) brown gravelly deposits (pleistocene); and (15) Ogallalla formation (miocene). (Lantz-PTT)
W89-09272

8. ENGINEERING WORKS

8A. Structures

SYSTEM FOR THE ONE-STEP DEWATERING OF A TRENCH AND THE CONSTRUCTION OF A PIPELINE BED,
D. R. Ashbaugh.
U.S. Patent No. 4,462,715; July 31, 1984, 5p, 5 fig. Official Gazette of the United States Patent Office, Vol 1044, No 5, p 2002, July 31, 1984.

Descriptors: *Patents, *Trenches, *Pipelines, *Construction methods, *Conveyance structures, Pumping, Pumps, Pipes, Dewatering, Seepage.

A stone-laying box for sewer and water pipelines simultaneously lays a stone bed with higher level packed side walls which shore up the bottom sides walls of a trench while pumping water out of the trench and pushing cascaded sandy ground which has fallen into the trench vehicle used to dig the trench. The trench box is moved along the trench incrementally while the trench is being dug. The system consists of a dewatering box, within which a pump is mounted to permit water to be pumped out of the box while the stone in the box is being ejected in the form of a U-shaped pipeline supporting bed. The bed has side walls of increased height to shore up the side walls of the trench. The bed-laying function is accomplished when the box is pushed forward by the trenching vehicle without the need for motive power, which would add considerably to the cost. (Cremmins-AEPCO)
W89-08278

METHOD OF PRODUCING AND LAYING A BARRIER STRUCTURE,
O. F. Larson.
U.S. Patent No. 4,541,751; September 17, 1985, 9p, 15 fig. Official Gazette of the United States Patent Office, Vol 1058, No 3, p 1218, September 17, 1985.

Descriptors: *Patents, *Barriers, *Erosion control, *Bank erosion, *Beach erosion, Silting, Construction methods, Ballast, Bank protection, Pipelines.

An elongated barrier on land controls bank or beach erosion and in water protects the coast and prevents siltation in a waterway or erosion along a submarine installation, such as a pipeline. One or more hollows occupy the interior of the lightweight barrier, which, when laid, is filled with natural sedimentary ballast. The ballast is preferably taken from the area adjacent to the installation site to avoid anchoring. Having a wide base, the barrier avoids undermining by waves and currents. It comprises an inexpensive, hollow, and elongate structure with a height/base width ratio less than 1. The ballast material is placed artificially or naturally in at least part of the hollows during or immediately after laying of the barrier. (Cremmins-AEPCO)
W89-08288

APPARATUS FOR IMPEDING FINE SEDIMENT DEPOSITION IN HARBORS AND NAVIGATIONAL CHANNELS,
California Univ., Berkeley. Regents.
For primary bibliographic entry see Field 4D.
W89-08291

JONGLEI CANAL: IMPACT AND OPPORTUNITY.
For primary bibliographic entry see Field 6G.
W89-08466

SUBMERSIBLE-TYPE TAINTER GATE FOR SPILLWAY, MARSEILLES LOCK AND DAM: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. R. Cooper.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A204592, price codes: A05 in papre copy, A01 in microfiche. Technical Report HL-89-1, January 1989. Final Report. 81p, 5 fig, 7 tab, 5 photos, 44 plates.

Descriptors: *Radial gates, *Inland waterways, *Hydraulic structures, *Tainter gates, *Spillways, *Locks, *Dams, *Hydraulic models, Model studies, Gates, Performance evaluation, Mathematical models, Mathematical equations, Stilling basins.

A 1:20-scale hydraulic model simulated a 120-ft-wide section of the spillway and stilling basin including one freely suspended 60-ft-wide by 16-ft-high submersible tainter gate. The magnitude and frequency of the forces acting on the cable supporting each end of the gate were measured. Tests indicated that there was a likelihood of the cables being subjected to exciting forces occurring at a random frequency with flow (a) over and (b) under the subject gate. The magnitude of these forces was about 1% of the total gate weight. Discharge characteristics and coefficients and stilling basin performance with various operating scenarios were determined. (Author's abstract)
W89-08486

ABIQUIU DAM AND RESERVOIR, RIO GRANDE BASIN, RIO CHAMA, NEW MEXICO: EMBANKMENT CRITERIA AND PERFORMANCE REPORT.
Corps of Engineers, Tulsa, OK.Tulsa District.
For primary bibliographic entry see Field 8D.
W89-08505

PRELIMINARY ASSESSMENT OF AN AIRBORNE THERMAL VIDEO FRAME SCANNING SYSTEM FOR ENVIRONMENTAL ENGINEERING SURVEYS,
Surrey Univ., Guildford (England).
For primary bibliographic entry see Field 7B.
W89-08573

APPLICATION OF PHYSIOGRAPHIC PHOTO INTERPRETATION TECHNIQUE TO ANALYSE THE ENIGMATIC DRAINAGE PROBLEM OF THE HYDERABAD METROPOLITAN REGION, PAKISTAN,
Soil Survey of Pakistan, Lahore.
For primary bibliographic entry see Field 7C.
W89-08605

CANAL DESIGN BY AN ARMOURING PROCESS,
Shaw Mont Newfoundland Ltd., St. John's.
P. C. Helwig.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 329-352, 2 tab, 9 fig, 11 ref.

Descriptors: *Erosion control, *Bank stabilization, *Canal linings, *Canals, *Canal design, *Channel erosion, *Hydroelectric plants, Canal construction, Canal linings, Armoring, Design criteria, Cost analysis, Costs, Newfoundland, Canada.

The Hinds Lake Development in Newfoundland, Canada is a medium head hydroelectric scheme (head = 220 meters) having an installed capacity of 75 MW. It was completed in 1980 at a cost of $80 million (Canadian). the Power Canal is a major feature of this development. It is a hillside canal lined with pit-run glacial till and relies upon self-armoring to resist erosion. By relying on an armoring process the conventional armour zone was not needed, thus saving about $500,000. Three different canal cross-sections were evolved to deal with the different types of terrain along the canal route. In addition, surface runoff draining into the canal had to be dealt with, as well as controlling benching at the waterline and rilling and gullying of the liner above water level. The design approach followed a stepwise procedure, dealing first with the basic canal hydraulics followed by a detailed analysis of the armoring process using Gessler's method. A completely deterministic description of the armoring process based on the behavior of individual particles is a very complex analytical problem. It is much more practical to treat the armoring process as a stochastic phenomenon and to look at the 'average' behavior of sediment particles. The weight per unit area of the armor coat and eroded material, as well as depth of material removed by erosion is also estimated. Subsequent operating experience has confirmed that this design approach is reliable and cost-effective when sources of suitable materials are readily available. (See also W89-08934) (White-Reimer-PTT)
W89-08945

DESIGN PROBLEMS IN GRAVEL-BED RIVERS, ALASKA,
Harza Engineering Co., Chicago, IL.
B. Wang, S. R. Bredthauer, and E. A. Marchegiani.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 869-891, 4 tab, 6 fig, 23 ref.

Descriptors: *Dam design, *Gravel, *River beds, *Alluvial channels, *Sedimentation, *Reservoirs, *Reservoir silting, *Dams, *Sediment transport, *Alaska, Susitna River, Chulitna River, Yukon River, Glacial streams, Streams, Rivers, Glacial sediments, Reservoir design, Bank erosion, Thermo-erosional niching, Sediment load, Aggradation, Degradation, Frozen ground, Seepage.

The Susitna River and its major tributaries are glacial fed, with high sediment concentrations in the summer and near-zero concentrations in the winter. Despite the high sediment concentrations, sedimentation in the proposed reservoirs will not significantly reduce their useful capacity over a 100 year period. Due to the large bed material downstream of the dams, little downstream degradation is expected due to trapping of sediments by the reservoirs. Significant aggradation could occur

below the Susitna River's confluence with the Chulitna River, which has a similar annual flow but a much larger sediment load due to the high proportion of glaciers in the basin. The primary bank erosion process on the Yukon River at Galena is thermo-erosional niching. Thermo-niching occurs when warm water flows against frozen silt, rapidly thawing the material and transporting it away. The niching continues until the overhanging blocks of frozen material fail and slump into the river. Further niching is limited while the failed blocks are eroded away, or when the water level drops to the level of the sand and gravel underlying the frozen silt. Due to thaw-unstable characteristics of the frozen silt, it was recommended that it be removed down to the contact with sand and gravel, and replaced with suitable material. Other considerations such as seepage and piping, abrasion of concrete surface and hydromachineries, sedimentation in diversion tunnels and effects on tailwater by aggradation and degradation will also affect the design of the dams and related structures. (See also W89-08934) (White-Reimer-PTT)
W89-08962

DESIGN OF DEPRESSED INVERT CULVERTS,
Alaska Univ., Fairbanks. Water Research Center.
For primary bibliographic entry see Field 8B.
W89-09109

NATIONAL AND REGIONAL TRENDS IN WATER-WELL DRILLING IN THE UNITED STATES, 1964-84,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-09250

8B. Hydraulics

BASIC HYDRAULIC PRINCIPLES OF OPEN-CHANNEL FLOW,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08456

FLOW SEPARATION CONDITIONS AT PIPE WALLS OF WATER DISTRIBUTION MAINS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
R. G. Eile: ', and R. M. Clark.
Available from the National Technical Information Service, Springfield, VA 22161, as PPB88-220702. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/130, June 1988. 10p, 1 fig, 4 ref.

Descriptors: *Flow separation, *Pipes, *Water conveyance, *Pipe flow, Water distribution, Potable water, Corrosion, Water quality, Hydraulic structures, Biofilms, Fluid dynamics, Model studies.

Biofilm formations on pipe walls have been found in potable water distribution mains. The biofilm layers contribute to accelerated corrosion rates, increased flow resistance, and formation of encrustations that may deteriorate drinking water quality. Research to evaluate the dependency on viscous pipe flow parameters and conditions at the pipe wall was conducted. Calculations illustrate that properties of separated flow conditions in cavities along the walls of water pipes can be determined from the governing equations of fluid dynamics. The self-purging of cavity-particle constituents was shown by modeling to be dependent upon diameter, specific gravity, and initial locations in the flow field. (Author's abstract)
W89-08485

DISCHARGE RATINGS FOR CONTROL GATES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
A. J. Heinitz.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 85-4105, 1986. 43p, 15 fig, 6 tab, 12 ref.

Descriptors: *Hydraulic properties, *Hydraulic gates, *Mississippi River, *Gates, *Locks, *Dams, *Gaging, *Discharge measurement, *Ratings, Iowa, Water level, Discharge capacity, Discharge coefficient, Mathematical studies, Hydraulic models.

The water level of the navigation pools on the Mississippi River are maintained by the operation of tainter and roller gates at the locks and dams. Discharge ratings for the gates on Lock and Dam 11, at Dubuque, Iowa, were developed from current meter discharge measurements made in the forebays of the gate structures. Methodology is given to compute the gate openings of the tainter gates accurately. Discharge coefficients, in equations that express discharge as a function of tailwater head, forebay head, and height of gate opening, were determined for conditions of submerged-orifice and free-weir flow. A comparison of the rating discharges to the hydraulic model rating discharges is given for submerged-orifice flow for the tainter and roller gates. (Author's abstract)
W89-08720

COMPUTER PROGRAM FOR ANALYZING CHANNEL GEOMETRY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-08756

EFFECT OF EMBANKING ON RIVER AND SEA FLOODS,
International Inst. of Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 4A.
W89-08888

INTRODUCTION TO GROUNDWATER HYDRAULICS--A PROGRAMMED TEXT FOR SELF-INSTRUCTION (INTRODUCCION A LA HIDRAULICA DE AGUAS SUBTERRANEAS),
G. D. Bennett.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Techniques of Water-Resources Investigations, Book 3, Chapter B2 (Tecnicas de Investigaciones de Recursos Hidricos del Servicio Geologico de los Estados Unidos, Libro 3, Capitulo B2). 1987. 167p, 52 ref. Translated by Victor Ricaldi and Maria Victoria Avendano.

Descriptors: *Hydraulics, *Geohydrology, *Groundwater, *Groundwater movement, *Darcys law, *Training, *Translations, Groundwater resources, Aquifer characteristics, Analytical techniques, Equations, Groundwater storage.

This manual is an introduction to the hydraulics of groundwater flow. With the exception of a few discussions in standard text format, the material is presented in programmed form. Emphasis has been placed upon theory rather than application. Basic principles of groundwater hydraulics are outlined, their uses in developing equations of flow are demonstrated, representative formal solutions are considered, and methods of approximate solution are described. At some points, rigorous mathematical derivation is employed; elsewhere, the development relies upon physical reasoning and plausibility argument. Since this text is an introduction to the material, the discussion is restricted for the most part to the flow of homogeneous fluids through a porous, homogeneous, and isotropic medium--that is to say, in a medium whose properties do not change as a function of location or direction. The reader is presumed to have an understanding of calculus and physics at the secondary level. This manual was translated into Spanish form a manual originally printed in English in 1976. (See also W77-03884) (Shidler-PTT)
W89-09010

COMPUTATION OF WATER-SURFACE PROFILES IN OPEN CHANNELS,
For primary bibliographic entry see Field 2E.
W89-09014

DESIGN OF DEPRESSED INVERT CULVERTS,
Alaska Univ., Fairbanks. Water Research Center.
M. C. Jordan, and R. F. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-233416. Price codes: A04 in paper copy, A01 in microfiche. Final Report, FHWA-AK-RD-87-23, June 1987. 64p, 16 fig, 4 tab, 27 ref, append.

Descriptors: *Culverts, *Hydraulic structures, *Hydraulic properties, *Design standards, Mathematical studies, Literature review, Hydraulic models, Mathematical models, Flow velocity.

The hydraulic characteristics of a depressed invert culvert were studied and a design procedure is developed. The hydraulic characteristics were studied by reviewing pertinent literature and by the use of a hydraulic model. The design procedure is similar to that already used by state hydrologists. Formulas for determining the geometric properties of a depressed invert culvert are presented. The hydraulic model was used to determine the discharge coefficients for a depressed invert culvert flowing under inlet control and set flush to a vertical headwall. A literature review was performed which examined velocity profiles, flow over permeable beds, and flow resistance in culverts and over rough beds. The design procedure is applicable to depressed invert culverts flowing under nonsubmerged conditions and set flush to a vertical headwall. The design procedure can be used as an outline for the development of a comprehensive design manual for depressed invert culverts. (Author's abstract)
W89-09109

8C. Hydraulic Machinery

DEVELOPMENT OF METHODOLOGIES FOR DETERMINING HYDROPOWER WATER STORAGE STRATEGIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-08266

SUBMERSIBLE-TYPE TAINTER GATE FOR SPILLWAY, MARSEILLES LOCK AND DAM: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W89-08486

APPLICATIONS OF MECHANICAL PUMPS AND MIXERS TO IMPROVE WATER QUALITY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W89-08543

MODEL FOR THE OPERATION OF SPILLWAY GATES IN PLUVIAL FLOODS,
Ministry of Public Works, Santiago (Chile). Irrigation Directorate.
For primary bibliographic entry see Field 4A.
W89-08889

8D. Soil Mechanics

ANALYSIS OF BANK PROTECTION USING A PROBABILITY OF MOTION APPROACH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W89-08253

ABIQUIU DAM AND RESERVOIR, RIO GRANDE BASIN, RIO CHAMA, NEW MEXICO: EMBANKMENT CRITERIA AND PERFORMANCE REPORT.
Corps of Engineers, Tulsa, OK.Tulsa District.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A1877 342, price codes: A10 in paper copy, A01 in microfiche. April 1987. 242p, 7 tab, 4 photos, 81 plates.

Descriptors: *Embankments, *Rockfill dams, Abiquiu Dam, Design standards, Dam construction, Performance evaluation.

In December 1981, the Corps of Engineers outlined the need for, and scope of, embankment reports, and authorized their preparation for all new earth and earth-rockfill construction projects. Authorization was also made for existing projects where significant remedial treatment, project complexity or approaching obsolescence make it desirable to have such reports. Abiquiu Dam is a project which has had significant post construction remedial treatment. This report provides the significant information needed by engineers to: (1) familiarize themselves with the project; (2) re-evaluate the embankment in the event unsatisfactory performance occurs; and (3) provide guidance for designing comparable future projects. Included in this report are a summary of design data, design assumptions, computations, specification requirements, construction data, field control and record control test data, and embankment performance as monitored by instrumentation. (Lantz-PTT)
W89-08505

RIVER BED SCOUR AND CONSTRUCTION OF STONE RIPRAP PROTECTION,
Northwest Hydraulic Consultants Ltd., Edmonton (Alberta).
V. J. Galay, E. K. Yaremko, and M. E. Quazi.
IN: Sediment Transfer in Gravel-Bed Rivers. John Wiley & Sons, New York. 1987. p 353-379, 1 tab, 19 fig, 41 ref.

Descriptors: *Hydraulics, *Riprap, *Scour, *Channel erosion, *Stream erosion, *Bank protection, *Bank stabilization, *River beds, *Streambeds, Channel scour, Vortices, Water currents, Bank erosion, Design criteria.

Scour in rivers and canals is generally the result of secondary currents or vortices that occur in conjunction with river features such as bends, abrupt changes in flow direction, obstructions, constrictions, confluences, subsurface sills, control structures and piers of various types and sizes. The severity (depth) and extent of scour depends on the strength of the secondary currents developed at the concerned river feature. Although various theoretical relationships for predicting the strength of secondary currents have been developed, calibration from field and/or flume data are still required. Different conditions for scour development have been identified from a variety of field studies, consulting cases, and laboratory research. Removal of toe material through development of a scour hole is the most common mechanism for initiating streambank failure. Toe protection is most commonly provided by a 'launching' apron, which involves the use of a material that can readily conform to a scour hole while maintaining its integrity and ability to protect underlying bank material. Stone, because of its flexibility and provided it is of proper size and durability, offers an ideal material for the launching apron process. Recently there has been an effort to develop a simple but effective means of monitoring gradations of stone riprap material using a surface sampling technique. A representative picture of the proportional area occupied by various sizes is obtained, and a by-number analysis is used to analyze the distribution of the sample sizes. A gradation curve is then drawn relating stone sizes and frequency distribution. Since riprap specifications are typically provided in terms of stone weight, a sample set of stones is weighed and size dimensions determined to establish a stone size versus weight relationship. (See also W89-08934) (White-Reimer-PTT)
W89-08946

FORMATION AND FAILURE OF NATURAL DAMS,
Geological Survey, Vancouver, WA. Water Resources Div.
J. E. Costa, and R. L. Schuster.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-392, 1987. 39p, 13 fig, 6 tab, 118 ref.

Descriptors: *Dam failure, *Natural dams, *Landslides, *Debris dams, Glaciers, Avalanches, Moraines, Glacial drift, Ice, Glacial lakes.

Of the numerous kinds of dams that form by natural processes, dams formed from landslides, glacial ice, and neoglacial moraines present the greatest threat to people and property. The most common types of mass movements that form landslide dams are rock and debris avalanches, rock and soil slumps and slides, and mud, debris, and earth flows. The most common initiation mechanisms for dam-forming landslides are excessive rainfall and snowmelt and earthquakes. Landslide dams can be classified into six categories based on their relation with the valley floor. Type I dams (11%) of the 81 landslide dams around the world that were classifed do not reach from one valley side to the other. Type II dams (44%) span the entire valley flood, occasionally depositing material high up on opposite valley sides. Type III dams (41%) move considerable distances both upstream and downstream from the landslide failure. Type IV dams (1%) are rare and involve the contemporaneous failure of material from both sides of a valley. Type V dams (1%) are also rare, and are created when a single landslide sends multiple tongues of debris into a valley forming two or more landslide dams in the same surfaces, that extend under the stream or valley and emerge on the opposite valley side. Many landslide dams fail shortly after formation. Overtopping is by far the most common cause of failure. Glacial ice dams can produce at least nine kinds of ice-dammed lakes. The most dangerous are lakes formed in main valleys dammed by tributary glaciers. Failure can occur by erosion of a drainage tunnel under or through the ice dam or by a channel over the ice dam. Cold polar ice dams generally drain supraglacially or marginally by downmelting of an outlet channel. Warmer temperate-ice dams tend to fail by sudden englacial or subglacial breaching and drainage. Late neoglacial moraine-dammed lakes are located in steep mountain areas affected by the advances and retreats of valley glaciers in the last several centuries. The most common reported failure mechanism is overtopping and breaching by a wave or series of waves in the lake, generated by icefalls, rockfalls, or snow or rock avalanches. Melting of ice-cores or frozen ground and piping and seepage are other possible failure mechanisms. (Lantz-PTT)
W89-09257

8E. Rock Mechanics and Geology

WELL CONSTRUCTION, LITHOLOGY, AND GEOPHYSICAL LOGS FOR BOREHOLES IN BEAR CREEK VALLEY NEAR OAK RIDGE, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08357

MAP OF BEDROCK-SURFACE TOPOGRAPHY IN PARTS OF THE PATERSON AND POMPTON PLAINS QUADRANGLES, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-08419

HYDROLOGIC AND GEOCHEMICAL MONITORING IN LONG VALLEY CALDERA, MONO COUNTY, CALIFORNIA, 1982-1984,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-08808

SYNTHESIS OF BOREHOLE GEOPHYSICAL DATA AT THE UNDERGROUND RESEARCH LABORATORY, MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
W. S. Keys.
Available from National Technical Information Service, Springfield, VA 22161, as DE84-015470, price codes: A03 in paper copy, A01 in microfiche. Technical Report BMI/OCRD-15, July 1984. 43p, 19 fig, 2 tab, 7 ref. DOE Contract DE-A102-83CH10143.

Descriptors: *Borehole geophysics, *Geophysics, *Boreholes, *Manitoba, *Data interpretation, *Geohydrology, Canada, Waste management, Waste disposal, Groundwater movement, Flow velocity, Geologic fractures, Uranium.

A suite of borehole-geophysical logs, supported by core data, was used to describe the rock matrix and fractures in a granite pluton near Lac du Bonnet, Manitoba, Canada. The site is being developed by Atomic Energy of Canada Limited, as an underground research laboratory to conduct geotechnical research and to validate predictive models as part of Canada's nuclear fuel, waste management program. However, the site is not planned to be used for waste disposal. Geophysical well logs were used to distinguish and correlate rock types and fractures between drill holes. Two significant fractures zones that are two of the major zones of groundwater movement at the site were identified by acoustic-televiewer logs. A new heat-pulse flowmeter provided repeatable measurements of very low-velocity, vertical flow in drill holes which enabled the identification of specific fractures that were transmitting water. Borehole gamma spectra showed that some fractures are enriched in uranium, and others may be depleted. Some of the advantages of synthesizing available borehole-geophysical logs at a site in fractured plutonic rocks are described and how this information can contribute to an understanding of the geohydrologic conditions at the site is discussed. (Author's abstract)
W89-08980

POST-CRETACEOUS UPLIFT OF THE SIOUX QUARTZITE RIDGE IN SOUTHEASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
N. C. Koch.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-419, 1986. 10p, 5 fig, 19 ref.

Descriptors: *Tectonic uplift, *Structural geology, *Uplift, *Geologic formations, *South Dakota, *Geology, Geologic fractures.

Evidence of a post-Cretaceous uplift of the Sioux Quartzite ridge in southeastern South Dakota consists of deformation of the Dakota Formation, Graneros Shale, Greenhorn Limestone, Carlile Shale, and Niobrara Formation of Cretaceous age. The Greenhorn is warped upward about 400 ft on the Sioux Quartzite with a formation dip ranging from 30-50 ft/mi. Elsewhere in eastern South Dakota the dip of the Greenhorn ranges from 3-8 ft/mi. (Author's abstract)
W89-09131

FRACTURE CHARACTERIZATION AND FRACTURE-PERMEABILITY ESTIMATION AT THE UNDERGROUND RESEARCH LABORATORY IN SOUTHEASTERN MANITOBA, CANADA,
Geological Survey, Denver, CO. Water Resources Div.
F. L. Paillet.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. Water Resources Investigations Report 88-4009, 1988. 42p, 17 fig, 4 tab, 34 ref.

Descriptors: *Geohydrology, *Geologic fractures, *Permeability, Manitoba, Geophysics, Data acquisition, Boreholes, Logging (Recording), Groundwater movement.

Various conventional geophysical well logs were obtained in conjunction with acoustic tube-wave amplitude and experimental heat-pulse flowmeter measurements in two deep boreholes in granitic rocks on the Canadian shield in southeastern Manitoba. The objective of this study is the development of measurement techniques and data processing methods for characterization of rock volumes that might be suitable for hosting a nuclear waste repository. One borehole, WRA1, intersected several major fracture zones, and was suitable for testing quantitative permeability estimation methods. The other borehole, URL13, appeared to intersect almost no permeable fractures; it was suitable for testing methods for the characterization of rocks of very small permeability and uniform thermo-mechanical properties in a potential repository horizon. Epithermal neutron, acoustic transit time, and single-point resistance logs provided useful, qualitative indications of fractures in the extensively fractured borehole, WRA1. A single-point log indicates both weathering and the degree of opening of a fracture-borehole intersection. All logs indicate the large intervals of mechanically and geochemically uniform, unfractured granite below depths of 300 m in the relatively unfractured borehole, URL13. Some indications of minor fracturing were identified in that borehole, with one possible fracture at a depth of about 914 m, producing a major acoustic waveform anomaly. Comparison of acoustic tube-wave attenuation with models of tube-wave attenuation in infinite fractures of given aperture provide permeability estimates ranging from equivalent single-fractured apertures of less than 0.01 mm to apertures of > 0.5 mm. One possible fracture anomaly in borehole URL13 at a depth of about 914 m corresponds with a thin mafic dike on the core where unusually large acoustic contrast may have produced the observed waveform anomaly. No indications of naturally occurring flow existed in borehole URL13; however, flowmeter measurements indicated flow at < 0.05 L/min from the upper fracture zones in borehole WRA1 to deeper fractures at depths below 800 m. (Author's abstract)
W89-09144

MAP SHOWING OCCURRENCES OF SPRING-DEPOSITED TRAVERTINE IN THE CONTERMINOUS WESTERN UNITED STATES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7C.
W89-09150

PRELIMINARY SURFICIAL GEOLOGY MAP OF THE CHEYENNE URBAN AREA, LARAMIE COUNTY, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-09272

8F. Concrete

METHOD OF RAISING AND EXTENDING AN OCEAN BEACH,
J. Temple.
U.S. Patent No. 4,669,913; June 2, 1987, 5p, 3 fig, 2 ref. Official Gazette of the United States Patent Office, Vol 1079, No 1, p294, June 2, 1987.

Descriptors: *Patents, *Barriers, *Erosion control, *Beach erosion, Beaches, Sea walls, Seashores, Concrete construction, Reinforced concrete, Sand.

A barrier is built to form and extend the width of a sand beach at the ocean seashore by raising its level. After the low and high tide water levels are located, a solid reinforced concrete barrier is constructed laterally along the beach. The barrier forms an equilateral triangular cross sectional configuration with an apex at the top, a base at the bottom, and a seaward facing wall. The intersection of the base and the seaward facing wall are located at the existing low tide water level and the apex is disposed above the level of the beach to a height more than 12 inches and a maximum of about 18 inches below the high tide water level. Accordingly, sand is deposited on the high side of the beach when water approaches and recedes from the high tide level. By pumping sand and sea water over the barrier, sand builds up to the level of the apex on the land side and is also deposited on the ocean side, thereby totally submerging the barrier so that it does not interfere with bathers or sea creatures. (Cremmins-AEPCO)
W89-08294

8G. Materials

PLUMBING MATERIALS AND DRINKING WATER QUALITY,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5G.
W89-08967

METAL PIPING AND JOINING MATERIALS AND FITTINGS,
Copper Development Association, Inc., Greenwich, CT.
For primary bibliographic entry see Field 5F.
W89-08968

PLASTIC PIPING AND JOINING MATERIALS,
Plastics Pipe Inst., New York.
For primary bibliographic entry see Field 5G.
W89-08969

IMPACT OF LEAD PIPING AND FITTINGS ON DRINKING WATER QUALITY,
Environmental Protection Agency, Boston, MA. Water Supply Branch.
For primary bibliographic entry see Field 5F.
W89-08970

IMPACT OF COPPER, GALVANIZED PIPE, AND FITTINGS ON WATER QUALITY,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5F.
W89-08971

SUMMARY OF IMPACT OF METALLIC SOLDERS ON WATER QUALITY,
H2M Corp., Melville, NY.
For primary bibliographic entry see Field 5F.
W89-08972

IMPACT OF LEACHING BY PLASTIC PIPE, FITTINGS, AND JOINING COMPOUNDS,
SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5F.
W89-08973

NSF STANDARD AND CERTIFICATION PROGRAM FOR PLASTICS PIPE: STANDARD 14,
National Sanitation Foundation, Ann Arbor, MI. N. I. McClelland.
IN: Plumbing Materials and Drinking Water Quality. Noyes Publications, Park Ridge, New Jersey. 1986. p 77-81, 2 fig, 2 ref.

Descriptors: *Standards, *Plastics, *Pipes, *Drinking water, Regulations, Leachates, Pipelines, Arsenic, Antimony, Barium, Cadmium, Chromium, Lead, Mercury, Phenol, Selenium, Tin, Trichloroethylene, Polychloroethylene, Trichloroethane.

The National Sanitation Foundation (NSF) is a private, not-for-profit corporation, chartered in 1944 under Michigan law. Its mission is to develop and administer programs relating to public health and the environment in areas of services, research, and education. Plastics piping system components have been tested at NSF since 1955, first in a comprehensive special study of leachate and toxicological testing, then under the provisions of Standard 14, Plastic Piping System Components and Related Materials. This Standard includes products for potable water; drain, waste, and vent; and other plumbing systems applications. The chemical parameters monitored and their maximum permissible limits (MPLs) are: antimony, arsenic, barium, cadmium, chromium, lead, mercury, phenolic substances RVCM, selenium, and tin. Currently, five volatile organic compounds proposed by the U.S. EPA for regulation are also being monitored to acquire a data base. They are CCl4, TCE, PCE, 1,2-dichloroethane; and 1,1,1-trichloroethane. (See also W89-08967) (Lantz-PTT)
W89-08974

TREATMENT OR WATER QUALITY ADJUSTMENT TO ATTAIN MCLS IN METALLIC POTABLE WATER PLUMBING SYSTEMS,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 5F.
W89-08975

EUROPEAN DEVELOPMENT IN USE OF PLUMBING MATERIALS,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5F.
W89-08977

8I. Fisheries Engineering

FISHERIES-OCEANOGRAPHY COORDINATED INVESTIGATIONS (FOCI) SURFACE METEOROLOGICAL OBSERVATIONS AT CHERNI ISLAND AND UGAIUSHAK ISLAND-FISCAL YEAR 1986,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2B.
W89-08501

OBSERVATIONS OF CURRENTS, SURFACE WINDS AND BOTTOM PRESSURE IN SHELIKOF STRAIT, AUTUMN 1984,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W89-08502

CASE STUDY OF MINIMUM STREAMFLOW FOR FISHERY HABITAT IN THE YAMPA RIVER,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-08964

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER RESOURCES RESEARCH GRANT PROGRAM PROJECT DESCRIPTIONS FISCAL YEAR 1985.
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W89-09106

EVALUATION OF THE STATE WATER-RESOURCES RESEARCH INSTITUTES,
Geological Survey, Reston, VA. Water Resources Div.
M. O. Ertel.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-85, 1988. 28p, 4 append.

Descriptors: *Water Resources Institutes, *Institutions, *Research priorities, Water resources development, Performance evaluation, Economic aspects, Legislation, Training.

Water resources research institutes, as authorized by the Water Resources Research Act of 1984 (Public Law 98-242), are located in each state and in the District of Columbia, Guam, Puerto Rico, and the Virgin Islands. Public Law 98-242 mandated an onsite evaluation of each of these institutes to determine whether '. . .the quality and relevance of its water resources research and its effectiveness as an institution for planning, conducting, and arranging for research warrant its continued support in the national interest.' The results of these evaluations, which were conducted between September 1985 and June 1987, are summarized. The evaluation teams found that all 54 institutes are meeting the basic objectives of the authorizing legislation in that they: (1) use the grant funds to support research that addresses water problems of state and regional concern; (2) provide opportunities for training of water scientists through student involvement on research projects; and (3) promote the application of research results through preparation of technical reports and contributions to the technical literature. The differences among institutes relate primarily to degrees of effectiveness, and most often are determined by the financial, political, and geographical contexts in which the institutes function and by the quality of their leadership. (Lantz-PTT)
W89-09200

9C. Research Facilities

EVALUATION OF THE STATE WATER-RESOURCES RESEARCH INSTITUTES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9A.
W89-09200

9D. Grants, Contracts, and Research Act Allotments

FISCAL YEAR 1987 INSTITUTE PROGRAM REPORT (ARKANSAS WATER RESOURCES RESEARCH CENTER).
Arkansas Univ., Fayetteville. Water Resources Research Center.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-110688/AS, price codes: A03 in paper copy, A01 in microfiche. Institute Program Report G-1409-01, June 1988. 38p. USGS contract 14-08-0001-G-1409. USGS project G-1409-01.

Descriptors: *Water Research Institutes, *Arkansas, *Research, *Information transfer, *Training, Education, Projects.

Arkansas' major water problems are floods, droughts, water quality, groundwater mining, institutional arrangements, laws, financing, environmental concerns and public awareness. From this generalized list of problems, a more specific list was developed by the Technical Advisory Committee to provide goals and priorities for the principal investigators. Specific areas for research include two projects on land use effects on water quality, one on optimal management of groundwater and one on dendrochronology. The land use projects concern the estimation of the potential ground and surface water pollution from land application of poultry litter and the land use effects on groundwater quality in the Ouachita Mountains. Another project involved the development of a combined quantity model for the optimal management of unsteady groundwater flow. The final research project covers long-term reconstruction and analysis of the White River stream flow. The information management systems projects include several diverse subjects. Work has continued on quantitative and qualitative aquatic algal data compilation to determine macrotrends. Another developed a database for verifying and modifying models for predicting non-point source pollution from silviculture. A third developed an inventory of water resource management expertise in Arkansas along with a summary of problems and research needs in Latin America. Another project was to develop a factor analysis of fish distribution patterns in Arkansas. The last one evaluated the amount of salt water contamination in Southern Arkansas. Eleven students received training this fiscal year. (Mack-UAR-WRRC)
W89-08329

FISCAL YEAR 1987 PROGRAM REPORT (ALABAMA WATER RESOURCES RESEARCH INSTITUTE),
Auburn Univ., AL. Water Resources Research Inst.
J. C. Warman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-110670/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G-1406-01, July 1988. 37p. USGS contract 14-08-0001-G1406. USGS project G-1406-01.

Descriptors: *Research, *Information transfer, *Training, *Alabama, *Water Research Institutes, Education, Projects.

Alabama's Water Resources Research Institute at Auburn University provided support for two continuing and four new research projects. Our program focuses on research and training that is responsive to identified priority problems of our State and Region. Project 02 is the final year of a two year project dealing with a sequencing batch reactor system for improved treatment of pentachlorophenol wastewater. Project 04 is the completion of a continuation project to verify, using three full scale waste treatment plants, the ability of Alk 5.75 to depict the operating conditions of actually operating anaerobic digesters, and to demonstrate the superiority of the proposed operating alkalinity titration to conventional methods with respect to ease of testing and predictive long-range insight into anaerobic digester operation. Project 03 was designed to provide a data base for 'impermeable' chalk formation of fracture parameters and lithologic variables with which to analyze and interpret the nature and extent of permeable zones and their potential control on groundwater flow. Project 05 hypothesized that relief would be decreased in a watershed being surface mined, reducing time to peak flow during storm events. A second hypothesis would relate that to a reduction in the natural capacity of the altered system to retain and cycle nutrients. Project 06 looks at an alternative to the conventional grant mechanism, now being eliminated, for municipal wastewater treatment facilities. Some localities are now seeking to fund their own projects. Others are pursuing an innovative arrangement, privatization. Project 07 looks at the development of an immobilized cell system for removal of nitrate pollution from the effluent of septic tanks. The Institute remains active in a modest information transfer program, development of support from a variety of extramural sources, and the works of the Alabama Environmental Planning Council. (Warman-Auburn U. WRRI)
W89-08332

FISCAL YEAR 1987 PROGRAM REPORT (ARIZONA WATER RESOURCES RESEARCH CENTER).
Arizona Water Resources Research Center, Tucson.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115463/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report No G1408-01, July 1987. 39p, 7 tab. USGS contract 14-08-0001-G1408. USGS project G1408-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Arizona, Education, Projects.

The research projects supported by the 87 Program addressed the following critical water issues in Arizona: water quality (project 05), water conservation (projects 03, 04 and 06), and water management (projects 02 and 07). Project 05 is examining groundwater in the Tucson Basin for the presence of radon gas with the goal of locating the problem regions. The objective of project 03 is to obtain information leading to the development of salt tolerant strains of alfalfa for use in areas of the state with saline waters. Project 04 examined the possibility of improving turfgrass-irrigation scheduling through microclimatological techniques. Project 06 is determining new, drought-resistant plant species for landscaping in the arid southwest. Project 02 examined various flood-prediction models for watershed conditions in the Central Highlands of Arizona and assessed the attitudes of public officials toward enforcing flood-plain ordinances. Project 07 is developing rainfall-runoff models for flash-flood forecasting in the southwest. The information transfer component of the institute continued to publish newsletters and issue papers and sponsored workshop and conferences. (USGS)
W89-08349

FISCAL YEAR 1987 PROGRAM REPORT (OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE),
Oklahoma Water Resources Research Inst., Stillwater.
N. N. Durham, and E. M. McTernan.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115455/AS, price codes: A03 in paper copy, A01 in microfiche. Report G1443-01, July 1988. 41p, 2 tab, 1 fig. USGS contract 14-08-0001-G1443. USGS project G1443-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Oklahoma, Education, Projects.

The FY 1987 Oklahoma Water Resources Research Institute research program addressed the issues of surface and groundwater quality and management of water resources. Research projects funded by the OWRRI to address these issues included: an investigation of the risks to groundwater quality associated with pesticide use; an examination of the cause and effect of rapid changes in shallow groundwater quality; the development of a modeling tool to improve surface runoff prediction from ungaged, non-urban sites; transport of eroded soil particles; and development of procedures to incorporate risk analyses into the design processes for water resources facilities. Information transfer activities included: continued publication of the newsletter; preparation of a complete listing of OSU faculty water research publications; and updating and distribution of the Technical Reports and General Publications Listing. (McTernan-OK WRRI)
W89-08350

FISCAL YEAR 1987 PROGRAM REPORT (WASHINGTON WATER RESEARCH CENTER),
Washington State Water Research Center, Pullman.
W. H. Funk.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-115471/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1456-01, August 1988. 21p. USGS contract 14-08-0001-G1456. USGS project G1456-01.

Descriptors: *Washington, *Water Research Institutes, *Research, *Information transfer, *Training, Education, Projects.

Water is a major resource and concern in the Pacific Northwest and the State of Washington. Two large river systems flow through the state. The largest and most important water resource is the Columbia River, which originates in Washington before flowing into the Pacific Ocean; the other is the Snake River, which originates in Wyoming and flows through Idaho. A system of 19 dams on the two river systems utilizes hydropower to produce 17,000 megawatts of electricity and furnishes 80% of the power needs of the region. Approximately 8.3 million acres of farmland are

irrigated in the Pacific Northwest and provide 65% of the total direct farm income. The river flows and watershed drainage account for 50,000 miles of streams and 8,000 freshwater lakes in the state and gives rise to widespread recreational boating, swimming, and fishing as well as commercial fishing. The sport and commercial fishing industry employ over 22,000 individuals and the wholesale value of salmon caught annually is over $90 million. Research efforts into the mitigation of water shortages during critical low flow and reduction in competitive uses were addressed by possible implementation of a computer-based irrigation scheduling system to encourage energy, soil, and water conservation, as well as the reduction of operation costs. To better manage Puget Sound waters, computer models must be developed and verified to calculate tidal transport in the Sound and predict pollutant movement in the water. For better management of aquifers, it is essential that the extent of the contamination as well as the steady-state and dynamic behaviors of sources of contamination be better understood. Parameter identification techniques for characterizing groundwater contaminants was undertaken and an understanding of how the retention and transport of the pesticides occur in the alluvial soils of Washington was investigated. The effect of trash rack vortices was studied in order to develop better design for the protection of migrating anadromous fishes through power house structures of dams. The State of Washington Water Research Center program is directed toward informing, educating, and solving or mitigating complex water problems of the state, region, and nation. (USGS)
W89-08351

FISCAL YEAR 1987 PROGRAM REPORT (PENNSYLVANIA CENTER FOR WATER RESOURCES RESEARCH),
Pennsylvania State Univ., University Park. Environmental Resources Research Inst.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-123475/AS, price codes: A03 in paper copy, A01 in microfiche. Environmental Resources Research Institute, Report ER8805, Program Report G1445-01, August 1988. 25p. USGS contract 14-08-0001-G1445. USGS project G1445-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Pennsylvania, *Education, Projects.

Three projects and a program of technology transfer were conducted during Fiscal Year 1987. Issues addressed included impacts of acid precipitation, protection of domestic water supplies and treatment of mine drainage. Complementing the Institute's continuing program on acid precipitation and its effects, a study was conducted on a second order stream basin in Pennsylvania. The study characterized the sources and hydrologic pathways of acid precipitation. The significance of soil water in modifying stream water chemistry during episodic events was demonstrated. In a continuing study comparisons are being made on the effectiveness of slow sand filtration and diatomaceous earth filtration in removing Giardia, Cryptosporidium, turbidity and coliform organisms. An economic solution to the problem of waterborne parasites for small community water supplies is the goal. A study was initiated to define the behavior of sedimentary iron and manganese in an acid mine drainage/wetland system to determine if and how such systems can function as permanent sinks for these metals. Technology transfer efforts emphasized educational programs and in-service training sessions for county-based extension service personnel. These sessions focused on groundwater management and protection. (USGS)
W89-08364

FISCAL YEAR 1987 PROGRAM REPORT (KENTUCKY WATER RESOURCES RESEARCH INSTITUTE),
Kentucky Water Resources Research Inst., Lexington.
R. Huffsey.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-123467/AS, price codes: A03 in paper copy, A01 in microfiche. Report No. G1424-01, August 1988. 28p. USGS contract 14-08-0001-G 1424. USGS project G1424-01.

Descriptors: *Water Research Institutes, *Kentucky, *Research, *Information transfer, *Training, Education, Projects.

The Annual Report of the Kentucky Water Resources Research Institute for Fiscal Year 1987 describes the problems and issues facing the State. The program goals and priorities describe the areas of water resources research the 1987 program addresses. A synopsis of each of the four research projects funded is included. The four projects are as follows: Project 03, 'The Effect of Prezonation on the Anaerobic Biodegradability of Resistant Phenolic Compounds', shows that ozonation improved anaerobic biodegradation of phenolic compounds and that various acids were produced which were then converted to methane gas. Project 04, 'Predicting Potential Aluminum Contamination of Surface and Groundwaters from Acid Sulfate Enriched Drainages Emanating from Low Neutralization Capacity Watersheds', found that soil sediment and mine soil was dominated by minerals with low neutralization capacity, and that mined watersheds that lack carbonates are more sensitive to aluminum toxicity. Project 05, 'Surface and Groundwater Contamination Potential from Three Triazine Corn Herbicides', is focusing on monitoring the movement of three weed control herbicides in silt loam soil. It was observed that there was very little difference in water and sediment runoff among the tillages used after the corn was harvested. Project 06, 'Teratogen Effects of Aquatic Pollutants on Embryos of Freshwater Fish and Amphibians', looked at toxicants that may be present in freshwater at low subacute concentrations and that may affect growth, development and behavior of aquatic biota. The Institute's technology transfer activities are included along with the cooperative arrangements; training accomplishments are also given. (USGS)
W89-08365

FISCAL YEAR 1987 PROGRAM REPORT (NORTH DAKOTA WATER RESOURCES RESEARCH INSTITUTE,
North Dakota Water Resources Research Inst., Fargo.
R. C. Schnell.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-121388/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report No. G1441-01, July 1988. 46p. USGS contract 14-08-0001-G1441. USGS project G1441-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *North Dakota, Education, Projects.

The research projects selected for funding in FY 1987 were concerned with water quality (detection and estimation of levels of dissolved organic agents) and status of wetlands in North Dakota. The water quality projects dealt with the development of new analytical techniques for in situ detection (using laser excited fluorescence spectroscopy) of pesticides and a combination of high performance liquid chromatography and electrochemical detection methods to increase selectivity and sensitivity of pesticide concentrations. Other projects were concerned with climatic factors (soil pH, moisture, temperature) on pesticide degradation, persistence, and movement. All parameters affect pesticide persistence. The effects of irrigation and rainfall on herbicide movement showed considerable effect on pesticide movement in various soil types. Toxicological studies were performed examining the effect of herbicides and combinations on toxicity parameters in animals. At the levels found environmentally in North Dakota no overt toxic symptoms have been observed. With regard to wetland research, an evaluation of current federal/state wetland legislation is under study to determine what impact it has had on economic development in North Dakota. These results will be helpful in shaping new legislation regarding wetlands. Information Transfer activities included: sponsoring WET workshops, co-sponsoring a North Dakota Groundwater Quality Symposium, publication of four technical reports, several scientific manuscripts, and presentations at national meeting. Twelve students (5 undergraduate, 3, M.S., 3 Ph. D., and 1 post-doctoral fellow) were supported by funding under this grant. (USGS)
W89-08366

FISCAL YEAR 1987 PROGRAM REPORT (MONTANA WATER RESOURCES CENTER),
Montana State Univ., Bozeman. Water Resources Research Center.
H. S. Peavy.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-121370/AS, price codes: A03 in paper copy, A01 in microfiche. Annual program report No. 1433-01, August 1988. 26p. USGS contract 14-08-0001-G1433. USGS project G1433-01.

Descriptors: *Montana, *Water Research Institutes, *Research, *Information transfer, *Training, Education, Projects.

The program summarized research that concluded the following (1) Phytoplankton biomass in Flathead Lake is not sensitive to reduction in zooplankton populations resulting from the introduction of Mysis relicta; however, phytoplankton biomass decreases and zooplankton increases when nutrients are added. (2) Concentrations of metals and arsenic in Clark Fork River sediments generally increase with decreasing size of sediment grains. (3) Simple models that relate dissolved metal concentrations to pH and alkalinity are as accurate as more complex models for use on the Clark Fork River. (4) There is no significant relationship between percent oxygen saturation and temperature or stream flow in the Clark Fork River. (5) Eutrophication models that are based on input/output of phosphorous predict poorer water quality in Lake Pend Oreille than is presently measured. (6) Local water wells will probably not be affected by de-watering underground coal mines along the Musselshell River, and the potential exists for storing excess stream flow in these mines more effectively than in surface reservoirs. (7) Stream bank disturbance is a greater source of sediment than livestock grazing on upland range by any of the currently accepted grazing management practices. In addition to the above research, an information transfer program includes a reference service to increase off-campus water managers/users access to available literature. Also, an informational audio slide/tape presentation and an associated brochure were prepared that documented the problems and opportunities of the Clark Fork River. Finally, an information management project assisted in the operation of a Groundwater Information Center. (Peavy-Mt St U)
W89-08367

FISCAL YEAR 1987 PROGRAM REPORT (NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE),
New Mexico Water Resources Research Inst., Las Cruces.
B. J. Creel.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-121362/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1438-01, August 1988. 30p, USGS contract 14-08-0001-G1438. USGS project G1438-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *New Mexico, Education, Projects.

The New Mexico Water Resources Research Institute's (WRRI) goal is to maintain a balanced research program that addresses water problems critical to New Mexico, the Southwest and the nation. Areas targeted as high priority for institute funding are (1) plant breeding and advanced genetic research to develop water conserving agricultural crops, (2) finding economically beneficial uses for water of impaired quality, and (3) a better understanding of groundwater processes, particularly re-

charge. The institute's USGS program supported two projects in the first area: a project that investigated the influence of specific leaf mass and internal leaf CO2, of alfalfa on water use efficiency, and a project that used advanced genetic engineering to identify single gene traits in plants which confer tolerances to environmental stresses. Area two was addressed by a project which continues research on oysters, clams and brine shrimp grown in a test facility using saline groundwater, and a project which investigated the economic potential for growing algae for oil (lipid) production. The third priority area was addressed by three projects. The first quantified recharge processes and provided explanations for the mechanisms of leakage and water quality deterioration in deep saline aquifers. Another project investigated vapor movement of water in the soil, which may be as important as liquid movement. And finally, a project was supported that evaluated whether three dimensional moisture flow of soil plays a role in calculating recharge or evapotranspiration. (Ortega Klett-NM WRRI)
W89-08368

FISCAL YEAR 1987 PROGRAM REPORT (OHIO WATER RESOURCES CENTER),
Ohio State Univ., Columbus. Water Resources Center.
R. C. Stiefel.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-143499/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G-1442-01, August 1988. 31p, 11 ref. USGS contract 14-08-0001-G-1442. USGS project G-1442-01.

Descriptors: *Water Research Institutes, *Ohio, *Research, *Training, *Information transfer, Education, Projects.

Ohio has an adequate water supply to meet its immediate needs. Most of Ohio's water problems are associated with water quality. Of primary concern are the sediments, nutrients, and acids in the surface waters from urban, agricultural and mining areas, and the toxic and hazardous waters that threaten the ground and surface waters. The focus of the 1987 State Water Research Program was directed at some of these needs. One project explored the design criteria for an innovative two-stage fluidized bed bioreactor in which the three major processes of cell immobilization, biodegradation, and biofilm control were combined in a single unit. This wastewater treatment process is felt to be a substantial evolution in the operational technology of bioreactor design and the successful completion of this project could result in the development of an innovative, reliable and considerably less costly wastewater treatment system. Another project's research was a cooperative effort with OEPA, ODNR, and the Nature Conservancy in examining and assessing the potential institutional and legal constraints that might hinder the development of programs for the management of non-point sources of pollution. Two projects explored the fate and transport of agricultural chemicals as they moved through soils toward the groundwater table. One studied the effects that subsurface agricultural drains have on the movement of the pesticides to groundwaters. The other explored the potential impacts that interactions and reactions between herbicides and existing humic materials have on the fate and transport of the herbicides in the groundwater. Training was provided for 10 students in 5 disciplines at 3 universities in Ohio. (Stiefel-OH St U., WRC)
W89-08371

FISCAL YEAR 1987 PROGRAM REPORT (SOUTH DAKOTA WATER RESOURCES INSTITUTE),
South Dakota State Univ., Brookings. Water Resources Inst.
A. R. Bender.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-143481/AS, price codes: A03 in paper copy, A01 in microfiche. Report No. G1449-01, 1988. 24p. USGS contract 14-08-0001-G1449. USGS project G1449-01.

Descriptors: *Water Research Institutes, *South Dakota, *Research, *Information transfer, *Training, Education, Projects.

Development of agricultural water use and the maintenance of adequate and safe water supplies for industrial and domestic use are high priority issues in South Dakota. The FY87 SWRIP supported three projects involving the concept of total water management and groundwater protection. Total water management considers the complex interactions of vegetative growth, agricultural management, soil chemical and physical properties, storage and movement of soil water, and the effects of those interactions on surface and groundwater quality. The information dissemination programs provided usable information to researchers, resource managers, agencies, and the public. The program was developed cooperatively by higher education faculty and state and federal agencies. (USGS)
W89-08372

FISCAL YEAR 1987 PROGRAM REPORT (IDAHO WATER RESOURCES RESEARCH INSTITUTE),
Idaho Univ., Moscow. Water Resources Research Inst.
G. L. Bloomsburg.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-143473/AS, price codes: A03 in paper copy, A01 in microfiche. Report No G1419-01, August 1988. 25p. USGS contract 14-08-0001-G1419. USGS project G1419-01.

Descriptors: *Idaho, *Research, *Training, *Water Resources Institutes, *Information exchange, Education, Projects.

This reports on the research and information dissemination activities of the Idaho Water Resources Research Institute during the 1987 fiscal year. Synopses are presented for the following research projects: Groundwater Management Under the Appropriation Doctrine - Part III; Developing an Integrated Model for Evaluating the Economic and Ecologic Effects of Reducing Nonpoint Source Pollution in a Palouse Watershed; Groundwater Contamination from Agriculturally Applied Pesticides; Development and Demonstration of Pump Station and Surface Diversion Systems for Water and Energy Efficiency Improvements; Application and Testing of an Index of Biotic Integrity to Assess the Land Use Activities on Receiving Streams in Idaho; Adsorptive Separation Methods; Use of Multivariate Modeling to Estimate Impacts of Groundwater Withdrawals on Streamflow for the Camas Creek Basin and Mean Annual Precipitation Map for Idaho. Information dissemination and workshop activities are also reported. (USGS)
W89-08373

FISCAL YEAR 1987 PROGRAM REPORT (TENNESSEE WATER RESOURCES RESEARCH CENTER).
Tennessee Univ., Knoxville. Water Resources Research Center.
Available from National Technical Information Service, Springfield, VA 22161, as PB89-155626/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1450-01, August 1988. 28p, 1 fig. USGS contract 14-08-0001-G1450. USGS project G1450-01.

Descriptors: *Water Research Institutes, *Training, *Research, *Information transfer, *Tennessee, Education, Projects.

This report provides an overview of the four (4) research projects and information transfer activities carried out during the FY 1987 program period by the Tennessee Water Resources Research Center. Project 02 focused on the fate and transport of synthetic organics in the vadose zone. The research included two families of chemistry: (1) the imidazolinones (represented by imazethpyr); and (2) polynuclear aromatic hydrocarbons (PNAs, represented by naphthalene). Project 03 involved the first phase of a two year study designed to obtain precise measurements of evapotranspiration (ET) and climatologic parameters simultaneously which will be used to develop an accurate ET prediction method for Tennessee and the mid-south. Project 04 is an assessment of groundwater contamination from oil and gas wells in the Cumberland Plateau region of Tennessee. This study was to determine the effects of active oil and gas exploration and production on the shallow groundwater quality in the aquifers underlying these well fields. Project 05 is concerned with the development of a process for the siting of hazardous waste treatment, storage and disposal (TSD) facilities in Tennessee. The project assessed the utility of different siting criteria for TSD facilities and evaluated alternative approaches for involving the public in the siting process. (USGS)
W89-08400

FISCAL YEAR 1987 PROGRAM REPORT (NEBRASKA WATER CENTER).
Nebraska Univ., Lincoln. Water Resources Center.
Available from National Technical Information Service, Springfield, VA 22161, as PB89-155618/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1434-1, August 1988. 33p. USGS contract 14-08-0001-G1434. USGS project G1434-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Nebraska, Education, Projects.

Water problems in Nebraska addressed by 1987 research program projects included: influence of soil type, tillage and precipitation patterns on groundwater recharge and surface water supplies; indicators of surface water pollution; retention of toxic organics in soil and water; assessing agricultural drought impacts; conservation of soil and water; and groundwater quality. Project 02 measured the runoff amounts and infiltration from rainfall on three soil types with different tillage practices. Project 03 tested the use of the Bacteriodes fragilis group and their bacteriophages as indicators of human fecal pollution of surface waters. Project 04 determined the influences of weather and drought on crop growth, development and yield, and in an effort to develop crop specific drought indices capable of assessing the impact of weather on crop production. Project 05 examined the effect of such interrow tillage techniques as subsoiling, basin tillage, and depression storage on the water infiltration and runoff on sloping lands. Project 06 is comparing grid and random sampling techniques to establish the most appropriate method of soil sampling for residual nitrate and to determine the effects of sampling time (fall vs spring) on soil nitrate distributions and quantities. Project 07 is identifying and quantifying soil factors from different mapping units and landscape positions which influence the retention of synthetic organic materials. Project 08 is developing a practical lysimeter for measuring leaching of chemicals and water from crop root zones. (Gold-U NB Water Ctr)
W89-08401

FISCAL YEAR 1987 PROGRAM REPORT (KANSAS WATER RESOURCES RESEARCH INSTITUTE),
Kansas Water Resources Research Inst., Manhattan.
H. S. Jacobs.
Available from National Technical Information Service, Springfield, VA 22161, as PB89-155600/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1423-01, June 1988. 25p. USGS contract 14-08-0001-G1423. USGS project G1423-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Kansas, Education, Projects.

The FY 1987 research program was directed at the priority research concerns of water quality, river basin management and water conservation. The four research projects which addressed the need to preserve water quality in Kansas groundwater and aquatic environments include studies in: (1) Delin-

eating the source of nitrates in farmstead wells using chemical and isotopic analysis of groundwater. (2) Assessing the movement of nitrate and atrazine through soil and into groundwater. (3) Assessing the occurrence and biological impacts of cadmium, lead, manganese and zinc in the Short Creek-Empire Lake aquatic system and (4) Determining the herbicide-induced alterations of aquatic habitats in Kansas. A water conservation study was directed toward factors which influence infiltration and runoff volumes from rainfall events and the development of a simple yet reliable estimation procedure. The study in river basin management was a systems approach to managing the Kansas River basin during times of drought. A total of 6 undergraduates, 7 Masters, and 4 Ph.D. degree students participated in the 1987 program. (Jacobs-KS State U., KWRRI)
W89-08403

FISCAL YEAR 1987 PROGRAM REPORT (FLORIDA WATER RESOURCES RESEARCH CENTER),
Florida Univ., Gainesville. Water Resources Research Center.
J. P. Heaney.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148498/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1415-01, July 1988. 24p, 5 tab. USGS contract 14-08-0001-G1415. USGS project G1415-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Florida, Education, Projects.

The 1987 Annual Center Report for Florida describes current water problems and issues of Florida. Also, it contains synopses of the following studies which were supported by this program: (1) Conservation of Water in Mineral Processing Operations in Florida, Brij M. Moudgil; (2) Field Evaluation of a Dispersion Model Based on Geological Parameters, David A. Chin, University of Miami; (3) Model of Porosity Development in a Coastal Carbonate System, Anthony F. Randazzo; (4) Determining Soil Water Seasonal Movement, M. E. Collins and R. B. Brown; (5) An Evaluation of Lake Restoration in FLorida, Forrest E. Dierberg, Florida Institute of Technology. Seven reports were published in FY-1987. 'Runoff', the semi-annual newsletter, was sent to over 100 readers including 170 faculty. Lastly, technology transfer activities, cooperative arrangements with other groups, and training accomplishments are described. (USGS)
W89-08435

FISCAL YEAR 1987 PROGRAM REPORT (MINNESOTA WATER RESOURCES RESEARCH CENTER),
Minnesota Univ., St. Paul. Water Resources Research Center.
P. L. Brezonik.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148472/AS, price codes: A04 in paper copy, A01 in microfiche. Report No. G1430-01, Bulletin No. 128, August 1988. 54p.

Descriptors: *Water Research Institutes, *Minnesota, *Research, *Information transfer, *Training, Education, Projects.

This report summarizes activities of the University of Minnesota Water Resources Research Center for fiscal year 1987, covering the period July 1, 1987 through June 30, 1988. The report describes results of research projects sponsored by the center, its information transfer and coordination activities, and its involvement in training water resources scientists and engineers. During this period, the Center funded eight projects through its federal grant program. A wide range of issues and problems were addressed by the eight projects. Four were concerned with water quality aspects of Minnesota lakes, one each with lake-groundwater hydrology, wetlands, water quality, and treatment technology. Two lake projects developed new and improved methods to assess nutritional and trophic status of lakes, and a third project was concerned with assessing trophic status changes in prairie lakes of central Minnesota since agricultural activity began in the region during the mid 19th century. Another project examined historical trends of mercury contamination in lakes of northeastern Minnesota in relation to efforts to define the sources of contamination. (USGS)
W89-08436

FISCAL YEAR 1987 PROGRAM REPORT (WYOMING WATER RESEARCH CENTER),
Wyoming Univ., Laramie. Water Resources Research Inst.
S. P. Gloss.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-148480/AS, price codes: A04 in paper copy, A01 in microfiche. Program Report G1459-01, July 1988, 51p, 4 tab, 2 fig. USGS contract 14-08-0001-G1459. USGS project G1459-01.

Descriptors: *Water Research Institutes, *Research, *Information transfer, *Training, *Wyoming, Education, Projects.

Six research projects were funded under the FY 1987 program which included: (1) a field lysimeter study near Laramie, Wyoming was conducted to measure phreatophyte transpiration utilizing porometry and a weighing lysimeter; (2) four techniques were evaluated for measuring intragravel water velocity in five different compositions of salmonid substrate material; (3) a Paleozoic Aquifer of the Casper Formation was identified as a potential untapped groundwater source in Laramie County, Wyoming. Recharge investigations were conducted along a possible recharge boundary of the aquifer to try and quantify the recharge amount; (4) the impact of sedimentation and resulting spring flushing flows on the sediment were evaluated as to their effects on aquatic macroinvertebrates of a high mountain stream; (5) factors influencing upland sediment and runoff production were studied on a north central Wyoming watershed which produces approximately 75% of the suspended sediment load to the Bighorn River; (6) a multiobjective decision making approach was utilized to develop a waste load allocation management model for a stream. Information transfer was accomplished through field tours, professional papers, a newsletter, law journal publications, seminars and updating data and bibliographic information sources for the State of Wyoming on regular and state water issues. (USGS)
W89-08437

FISCAL YEAR 1987 PROGRAM REPORT (OREGON WATER RESOURCES RESEARCH INSTITUTE),
Oregon State Univ., Corvallis. Water Resources Research Inst.
P. C. Klingeman.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136873/AS, price codes: A03 in paper copy, A01 in microfiche. Program Report G1444-01, August 1988. 41p, 2 tab. USGS contract 14-08-0001-G1444. USGS project G1444-01.

Descriptors: *Water Resources Institutes, *Orgeon, *Research, *Information transfer, Education, Projects.

The FY 1987 Oregon Water Resource Research Institute program included six research projects addressing critical water problems in Oregon. Two projects advanced our understanding of groundwater protection: project 02, Laboratory Study of In-situ Reclamation Process for Metals-Contaminated Soils and project 04, Geostatistical Analysis of Pesticide Contamination in Groundwater Aquifers. Project 05, Behavior of Runoff-Derived Metals in a Well Defined Paved-Catchment/Retention Pond System, evaluated detention pond effectiveness in controlling urban stormwater contaminants. One project examined stream primary productivity for modified riparian habitats: project 03, Effects of Simulated Land-Use Practices on the Productive Capacity of Streams. One project examined a controversial control technology for aquatic weeds in lakes: project 06, Bioenergetics of Grass Carp: Water Quality Implications. One project explored whitewater recreation management strategies: project 07, Comparison of Whitewater Recreation Opportunities and Benefits of the Rogue, Deschutes and Clackamas Rivers, Oregon. Summaries of these projects and their principal research findings are presented. The FY 1987 Oregon WRRI program also included education and training activities for 30 graduate students from across campus in WRRI seminars plus seven graduate students in research training on WRRI projects. Information transfer activities were an important part of the WRRI program. (USGS)
W89-08441

FISCAL YEAR 1987 PROGRAM REPORT (VIRGIN ISLANDS WATER RESOURCES RESEARCH CENTER),
Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
J. H. Krishna.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136881/AS, price codes: A03 in paper copy, A01 in microfiche. Report No. G1455-01, October 1988. 15p. USGS contract 14-08-0001-G1455. USGS project G1455-01.

Descriptors: *Virgin Islands, *Water Resources Institutes, *Information transfer, *Research, *Training, Education, Projects.

The major areas of emphasis at the Virgin Islands water resources research center during fiscal year 1987 included cistern water quality studies in public housing projects and studies on residential water conservation practices. The water quality project conducted by the research center involved studies of ten cisterns over a ten month period at five public housing projects. The water conservation study involved a survey of 420 respondents. Two workshops were organized by the water resource research center on microbiological aspects of water in the U.S. Virgin Islands. The workshops provided information and training on water quality to local officials and technicians. Preliminary results from the research projects were presented at national and regional meetings. (USGS)
W89-08446

FISCAL YEAR 1987 PROGRAM REPORT (DISTRICT OF COLUMBIA WATER RESOURCES RESEARCH CENTER),
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-136899/AS, price codes: A03 in paper copy, A01 in microfiche. DC WRRC Report No. 88 (Report G1414-01), Sept 1988. 23p. USGS contract 14-08-001-G1414. USGS project G1414-01.

Descriptors: *Water Research Institutes, *Training, *Research, *Technology transfer, *District of Columbia, Education, Project.

Fy 1987 has been a year of changes for the DC-WRRC. In its new facilities the Center has installed the Ecology Laboratory, the Sedimentation/Hydrology Laboratory, the Demonstration Room and Information Center. However, the main efforts of the Center during the 1987 program year focused on its research program and its technology transfer activities. This FY 1987 Institute Final Report describes the completed and continuing projects that the D.C Water Resources Research Center conducted between August 1, 1987, and July 31, 1988. The projects entitled 'The Anacostia River: Ecological Studies of River Pollution Biology'; 'The Impact of Erosion and Sedimentation on the Water Quality of the Estuarine Portion of the Anacostia River'; 'Activators and Inhibitors of Hydrilla Enzymes' are concerned with the Anacostia River, which is a tributary of the Potomac River. The project entitled: 'Speciation of Tributyltin Compounds in Water and Sediments using Mossbauer Sepctroscopy' addresses the fundamental issue of the development of a methodology for

the measurement and the future use of tributyltin compounds. The Technology Transfer/Public Education Program accomplishments included monthly seminars, symposia, exhibits, public tours, and publication of a quarterly newsletter. The other aspect of the Technology Transfer consisted of publication and distribution of research reports and proceedings. (USGS)
W89-08448

WATER RESOURCES RESEARCH GRANT PROGRAM PROJECT DESCRIPTIONS, FISCAL YEAR 1987.
Geological Survey, Reston, VA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open File Report 88-179, 1987. 72p, 2 tab.

Descriptors: *Grants, *Research priorities, Groundwater quality, Water quality management, Technology, Hydrologic cycle, Climates, Water resources management, Surface water.

This report contains information on the 34 new projects funded by the United States Geological Survey's Water Resources Research Grant Program in fiscal year 1987 and on 3 projects completed during the year. For the new projects, the report gives the grant number, project title, performing organization, principal investigator(s), and a project description that includes: (1) identification of water related problems and problem-solution approach (2) contribution to problem solution, (3) objectives, and (4) approach. The 34 projects include 12 in the area of groundwater quality problems, 12 in the science and technology of water quality management, 1 in climate variability and the hydrologic cycle, 4 in institutional change in water resources management, and 5 in surface water management. For the three completed projects, the report furnishes the grant number; project title; performing organization; principal investor(s); starting data; data of receipt of final report; and an abstract of the final report. Each project description provides the information needed to obtain a copy of the final report. The report contains tables showing: (1) proposals received according to area of research interest, (2) grant awards and funding according to area of research interest, (3) proposals received according to type of submitting organization, and (4) awards and funding according to type of organization. (Author's abstract)
W89-08634

WATER RESOURCES RESEARCH GRANT PROGRAM PROJECT DESCRIPTIONS FISCAL YEAR 1985.
Geological Survey, Richmond, VA. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 85-687, 1985. 25p.

Descriptors: *Water resources development, *Grants, Project planning, Economic aspects, Legislation.

Information on each of the 24 projects funded by the U.S. Geological Survey in FY 1985 under section 105 of Public Law 93-242 (the Water Resources Research Act of 1984) is presented, including the grant number, organization, the period of performance, and a brief description of the work to be carried out. (Lantz-PTT)
W89-09106

EVALUATION OF THE STATE WATER-RESOURCES RESEARCH INSTITUTES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9A.
W89-09200

U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER-RESOURCES PROGRAM, FISCAL YEAR 1987,
Geological Survey, Reston, VA. Water Resources Div.
B. K. Gilbert, and W. B. Mann.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-174, 1988. 36p, 6 fig, 2 tab, 18 ref, append.

Descriptors: *Water resources data, *Data acquisition, *US Geological Survey, *Governmental interrelations, *Project planning, Economic aspects, Hydrology, Research priorities, Groundwater pollution, Water quality control, Water supply, Water demand.

The U.S. Geological Survey's Federal-State Cooperative Water Resources Program (50-50 matching of funds) started in Kansas in 1895. During fiscal year (FY) 1987, hydrologic data collection, investigations, and research are being conducted in every state, Puerto Rico, and several territories in cooperation with 940 state, regional and local agencies. Federal funding of $55.3 million was matched by cooperating agencies; cooperators also provided $4.6 million unmatched, for a program total of about $115 million. The Cooperative Program accounted for almost 45% of the FY 1987 obligations of the Geological Survey's Water Resources Division. The principal areas of emphasis during the year included groundwater contamination, stream quality, water supply and demand, and hydrologic hazards. Information is presented on program functions and priorities. Data collection activities are also described as is work related to water resources contamination. Several examples of current (1987) investigations are provided. (Author's abstract)
W89-09205

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

DISTRIBUTED INFORMATION SYSTEM,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W89-09212

DEVELOPMENT OF A DATA BASE FOR WATER-QUALITY MODELING OF THE PATUXENT RIVER BASIN, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
G. T. Fisher, and R. M. Summers.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-379, 1987. American Society of Agricultural Engineers Paper No. 87-2046. 18p, 3 fig, 6 tab, 13 ref.

Descriptors: *Data storage and retrieval, *Water quality, *Patuxent River, *Maryland, *Model studies, Meteorology, Hydrologic data.

Procedures and rationale used to develop a data base and data management system for the Patuxent Watershed Nonpoint Source Water Quality Monitoring and Modeling Program of the Maryland Department of the Environment and the U.S. Geological Survey are described. A detailed data base and data management system has been developed to facilitate modeling of the watershed for water quality planning purposes; statistical analysis; plotting of meteorologic, hydrologic and water quality data; and geographic data analysis. The system is Maryland's prototype for development of a basin-wide water quality management program. A key step in the program is to build a calibrated and verified water quality model of the basin using the Hydrological Simulation Program--FORTRAN (HSPF) hydrologic model, which has been used extensively in large-scale basin modeling. The compilation of the substantial existing data base for preliminary calibration of the basin model, including meteorologic, hydrologic, and water quality data from federal and state data bases and a geographic information system containing digital land use and soils data is described. The data base development is significant in its application of an integrated, uniform approach to data base management and modeling. (Lantz-PTT)
W89-09251

10B. Reference and Retrieval

USE AND AVAILABILITY OF CONTINUOUS STREAMFLOW RECORDS IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7A.
W89-08429

INDEX TO SELECTED MACHINE-READABLE GEOHYDROLOGIC DATA FOR PRECAMBRIAN THROUGH CRETACEOUS ROCKS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-09259

10C. Secondary Publication And Distribution

LOCATION MAPS AND LIST OF U.S. GEOLOGICAL SURVEY REPORTS ON WATER RESOURCES IN ALASKA, 1950 TO 1988.
Geological Survey, Anchorage, AK. Water Resources Div.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open-File Report 88-344, 1988. 35p, 12 fig. Compiled by E. F. Snyder.

Descriptors: *Bibliographies, *Water resources, *Alaska, Maps, Glaciers, Pipelines.

Reports written by U.S. Geological Survey members between 1950 and 1988 on the water resources of Alaska are listed. Location maps are given for six geographic sections: Arctic Slope, West, Southwest, East-Central, Southcentral, and Southeast. Numbers on the location maps refer to the bibliographic citations. Reports are also cited for the following categories: Statewide and Topical, Glaciers, and Trans-Alaska Pipeline System. (USGS)
W89-08314

WATER RESOURCES ACTIVITIES IN NEW YORK, 1987-88,
Geological Survey, Albany, NY. Water Resources Div.
M. P. Marshall, and A. J. Finch.
Available from Books and Open File Report Section, USGS, Box 25425, Denver CO 80225. USGS Open-File Report 88-94, 1988. 55p, 1 fig, 66 ref.

Descriptors: *Hydrologic data, *New York, *Water resources data, *Groundwater, *Streamflow, *Surface water, Data collections, Hydrology, Aquifers.

The U.S. Geological Survey conducted more than 35 water resources projects in New York in 1987-88. These studies, done largely through cooperative joint-funding programs with the state, County, and local agencies, encompass statewide networks of measurement stations that provide continuous records of streamflow, groundwater levels, and water quality; they also address regional and local problems as well as critical problems of national scope. Some of the questions addressed by these studies are the effect of sewers on groundwater levels and streamflow on Long Island; the occurrence and transport of PCB residues within the upper Hudson River basin; the effect of acid rain on streams in the Catskill Mountains; the frequency and magnitude of floods statewide; the role of wetlands in improving the chemical quality of landfill leachate; the direction of groundwater movement from waste disposal sites near the Niagara River; and the location and potential well yields of stratified-drift aquifers in upstate New York. (USGS)

W89-08322

WATER RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO – FISCAL YEAR 1988,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. L. Knutilla.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-473, (1988). 165p, 5 fig, 3 tab.

Descriptors: *Hydrologic data collections, Stream gages, Observation wells, On-site investigations.

All hydrologic investigations in the New Mexico District in progress during fiscal year 1988 are summarized. The summaries include sections on the problem addressed, the objective and approach of the investigation, progress of the investigation. Reports released during 1986 and 1987 are listed. The New Mexico District office organization, cooperating agencies, and types of funding for the District operation are also summarized. (USGS)
W89-08374

WATER-RESOURCES ACTIVITIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1986 TO JUNE 30, 1987,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-08635

BIBLIOGRAPHY OF U.S. GEOLOGICAL SURVEY REPORTS ON THE WATER RESOURCES OF FLORIDA, 1886-1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
M. Claiborne, L. O. Nierstheimer, and N. D. Hoy.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 83-540, 1983. 311p.

Descriptors: *Water resources, *Groundwater, *Hydrologic data, *Bibliographies, *Florida, *Hydrologic budget, *Surface water, Data collections, Groundwater budget, Hydrologic data collections.

The U.S. Geological Survey (USGS) has been making investigations of the water resources of Florida since the latter part of the 19th century. Early work consisted mainly of data collection at a few spring and river sites at intermittent intervals with the exception of a statewide groundwater study made during 1910-12. In 1930, an office was established for surface water studies in Florida and in 1938 for groundwater studies. Since 1930, practically all of the water resources investigations made by USGS have been in cooperation with State and local agencies. The third edition, 'Bibliography of U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1982' includes reports approved for release in calendar years 1981 and 1982. In addition to updating the second edition (1981) several reports released prior to that time, which were inadvertently omitted, have been added. The bibliographic list of publications is arranged alphabetically by senior author. The publications are also indexed by geographic area and by subject. (Lantz-PTT)
W89-08662

FLOOD HYDROLOGY: PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON FLOOD FREQUENCY AND RISK ANALYSES, 14-17 MAY 1986, LOUISIANA STATE UNIVERSITY, BATON ROUGE, U.S.A.
D. Reidel Publishing Company, Boston, MA. 1987. 429p. Edited by Vijay P. Singh.

Descriptors: *Floods, *Flood frequency, *Risks, *Model studies, *Research priorities, *Symposium, Flood control, Flood protection, Hydrologic models, Streamflow forecasting.

Floods constitute a persistent and serious problem throughout the United States and many other parts of the world. Two aspects of the problem of flooding that have long been topics of scientific inquiry are flood frequency and risk analyses. Many new, even improved, techniques have recently been developed for performing these analyses, and provide the motivation for organizing the International Symposium on Flood Frequency and Risk Analyses. The objectives of this symposium were therefore (1) to assess the current state of the art of flood frequency and risk analyses, (2) to demonstrate applicability of flood frequency and risk models, (3) to establish complementary aspects of seemingly different models, (4) to enhance interdisciplinary interaction, (5) to discuss practice of flood frequency and risk analyses technology by federal agencies in the U.S., (6) to discuss research needs in frequency and risk analyses, and (7) to determine directions for further research. The symposium proceedings are divided into seven sections encompassing major hydrologic aspects of flood control and protection. Each section starts usually with an invited state-of-the-art paper, followed by contributed papers. Beginning with an assessment of hydrclogic modeling and limitations, and a future flood research agenda for the United States, the papers go on to discuss hydrology of floods, urban and coastal flooding, streamflow simulation and forecasting, flood control and protection, and flood control programs. (See W89-08864 thru W89-08898) (Fish-PTT)
W89-08863

INTERACTIVE PROGRAM TO DISPLAY USER-GENERATED OR FILE-BASED MAPS ON A PERSONAL COMPUTER MONITOR,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-09009

CONCEPTUAL DESIGN FOR THE NATIONAL WATER INFORMATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10D.
W89-09111

IDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
C. D. Blackwell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-167, 1988. 334p, 1 fig.

Descriptors: *Organization codes, *Indexing, *Computers, *Data storage and retrieval, Organizations.

Codes for the unique identification of public and private organizations listed in computerized data systems are presented. These codes are used by the U.S. Geological Survey's National Water Data Exchange (NAWDEX), National Water Data Storage and Retrieval System (WATSTORE), National Cartographic Information Center (NCIC), and Office of Water Data Coordination (OWDC). The format structure of the codes is discussed and instructions are given for requesting new books. (Author's abstract)
W89-09204

DISTRIBUTED INFORMATION SYSTEM,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W89-09212

INDEX TO SELECTED MACHINE-READABLE GEOHYDROLOGIC DATA FOR PRECAMBRIAN THROUGH CRETACEOUS ROCKS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
J. M. Spinazola, C. V. Hansen, E. J. Underwood, J. F. Kenny, and R. J. Wolf.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-396, 1987. 31p, 5 fig, 10 tab, 15 ref.

Descriptors: *Indexing, *Geohydrology, *Hydrologic data collections, *Kansas, *Data storage and retrieval, Computers, Water quality, Water level, Water use, Logging (Recording), Lithology, Hydraulic properties, Specific capacity, Aquifers, Groundwater mining.

Machine-readable geohydrologic data for Precambrian through Cretaceous rocks in Kansas were compiled as part of the USGS Central Midwest Regional Aquifer System Analysis. The geohydrologic data include log, water quality, water level, hydraulics, and water use information. The log data consist of depths to the top of selected geologic formations determined from about 275 sites with geophysical logs and formation lithologies from about 190 sites with lithologic logs. The water quality data consist of about 10,800 analyses, of which about 1,200 are proprietary. The water level data consist of about 4,480 measured water levels and about 4,175 equivalent freshwater hydraulic heads, of which about 3,745 are proprietary. The hydraulics data consist of results from about 30 specific capacity tests and about 20 aquifer tests, and interpretations of about 285 drill stem tests (of which about 60 are proprietary) and about 75 core-sample analyses. The water use data consist of estimates of freshwater withdrawals from Precambrian through Cretaceous geohydrologic units for each of the 105 counties in Kansas. Average yearly withdrawals were estimated for each decade from 1940 to 1980. All the log and water use data and the nonproprietary parts of the water quality, water level, and hydraulics data are available on magnetic tape from the USGS office in Lawrence, Kansas. (Author's abstract)
W89-09259

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
C. D. Blackwell.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-469, 1987. 78p.

Descriptors: *Information exchange, *Directories, *Institutions, *National Water Data Exchange.

The National Water Data Exchange (NAWDEX) is a national confederation of water-oriented organizations working together to improve access to water data. It consists of member organizations from all sectors of the water data community. This Directory provides the names, addresses, and telephone numbers of all NAWDEX member organizations and their designated NAWDEX representatives. (Author's abstract)
W89-09266

INDEX TO LIMNOLOGICAL DATA FOR SOUTH-CENTRAL ALASKA LAKES,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2H.
W89-09269

10D. Specialized Information Center Services

FLEXIBLE REGIONAL EMISSIONS DATA SYSTEM (FREDS) DOCUMENTATION FOR THE 1980 NAPAP EMISSIONS INVENTORY,
Alliance Technologies Corp., Bedford, MA.
For primary bibliographic entry see Field 5B.
W89-08545

COMPREHENSIVE LRIS OF THE KANANASKIS VALLEY USING LANDSAT DATA,
Calgary Univ. (Alberta).
For primary bibliographic entry see Field 7C.

W89-08607

LAND RESOURCE USE MONITORING IN ROMANIA, USING AERIAL AND SPACE DATA,
Institutul de Geodezie, Fotogrammetrie, Cartografie si Organizarea Teritoriului, Bucharest (Romania).
For primary bibliographic entry see Field 7C.
W89-08608

DEVELOPMENT OF A WATER-USE DATA SYSTEM IN MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 6D.
W89-08693

PLAN FOR THE DESIGN, DEVELOPMENT, IMPLEMENTATION, AND OPERATION OF THE NATIONAL WATER INFORMATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, Co 80225. USGS Open-File Report 87-29, 1987. 53p, 9 fig, 2 tab, 5 ref.

Descriptors: *Hydrologic data, *National Water Information System, *Water Data, *Water resources data, *Information exchange, *Data storage and retrieval, Water resources, Computers, Project planning.

The Water Resources Division of the U.S. Geological Survey is developing a National Water Information System (NWIS) that will integrate and replace its existing water data and information systems of the National Water Data Storage and Retrieval System, National Water Data Exchange, National Water-Use Information, and Water Resources Scientific Information Center programs. It will be a distributed data system operated as part of the Division's Distributed Information System, which is a network of computers linked together through a national telecommunication network known as GEONET. The NWIS is being developed as a series of prototypes that will be integrated as they are completed to allow the development and implementation of the system in a phased manner. It also is being developed in a distributed manner using personnel who work under the coordination of a central NWIS Project Office. Work on the development of the NWIS began in 1983 and it is scheduled for completion in 1990. This document presents an overall plan for the design, development, implementation, and operation of the system. Detailed discussions are presented on each of these phases of the NWIS life cycle. The planning, quality assurance, and configuration management phases of the life cycle also are discussed. The plan is intended to be a working document for use by NWIS management and participants in its design and development and to assist offices of the Division in planning and preparing for installation and operation of the system. (Author's abstract)
W89-08983

CONCEPTUAL DESIGN FOR THE NATIONAL WATER INFORMATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards, A. L. Putnam, and N. E. Hutchison.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 86-604, 1986. 37p, 8 fig, 3 ref.

Descriptors: *Information exchange, *Data storage and retrieval, *National Water Information System, *Information storage and retrieval, *Project planning, Computers, Computer programs, Indexing.

The Water Resources Division of the U.S. Geological Survey began the design and development of a National Water Information System (NWIS) in 1983. The NWIS will replace and integrate the existing data systems of the National Water Data Storage and Retrieval System, National Water Data Exchange, National Water-Use Information Program, and Water Resources Scientific Information Center. The NWIS has been designed as an interactive, distributed data system. The software system has been designed in a modular manner which integrates existing software functions and allows multiple use of software modules. The data of the existing water data, water use data, and water data indexing information by using a common relational data base management system. The NWIS will be operated on microcomputers located in each of the Water Resources Division's District offices and many of its state, subdistrict, and field offices. The microcomputers will be linked together through a national telecommunication network maintained by the U.S. Geological Survey. The NWIS is scheduled to be placed in operation in 1990. (Author's abstract)
W89-09111

REFLECTIONS ON WRITING HYDROLOGIC REPORTS,
Geological Survey, Reston, VA. Water Resources Div.
P. G. Olcott.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 87-398, (1987). 8p, 7 ref.

Descriptors: *Reports, *Report writing, *Writing, *Hydrology, Data interpretation.

Reporting of scientific work should be characterized by a logical argument that is developed through presentation of the problem, tabulation and display of data pertinent to the problem, and testing and interpretation of the data to prove hypotheses that address the problem. Organization of the report is vital to developing this logical argument: it provides structure, continuity, logic, and emphasis to the presentation. Each part of the report serves a specific function and each is linked by a connecting logic, the logical argument of the report. Each scientific report normally has a title, table of contents, abstract, introduction, body (of the report), and summary and/or conclusions. Organization of sections within the body of the report is exactly parallel to overall organization; subjects presented in the section title are developed by logical subdivisions and pertinent discussion. The summary and/or conclusions section culminates the logical argument of the report by drawing together and quantitatively reiterating the principal conclusions developed in the discussion. Supplemental information on report content, background of the study, additional data or details on procedures, and other information of interest to the reader is presented in the foreward or preface, list of illustrations or tables, glossaries, and appendixes. (Lantz-PTT)
W89-09261

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10C.
W89-09266

10F. Preparation Of Reviews

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 2: EFFECTS OF ACID-FORMING EMISSIONS ON SOIL MICROORGANISMS AND MICROBIALLY-MEDIATED PROCESSES,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5C.
W89-08487

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 3: ENVIRONMENTAL SULPHUR ISOTOPE STUDIES IN ALBERTA: A REVIEW,
Calgary Univ. (Alberta). Dept. of Physics.
For primary bibliographic entry see Field 5B.
W89-08488

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 4: CRITICAL REVIEW OF INORGANIC SULPHUR MICROBIOLOGY WITH PARTICULAR REFERENCE TO ALBERTA SOILS,
Calgary Univ. (Alberta). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-08489

ACID DEPOSITION PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 8: THE EFFECTS OF ACIDIC DEPOSITION ON ALBERTA AGRICULTURE, A REVIEW,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-08490

ACID DEPOSITION RESEARCH PROGRAM, BIOPHYSICAL RESEARCH. VOLUME 9: THE EFFECTS OF ACID DEPOSITION ON FORESTS,
Emporia State Univ., KS. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-08491

AMBIENT WATER QUALITY CRITERIA FOR SELENIUM-1987.
Environmental Protection Agency, Washington, DC. Criteria and Standards Div.
For primary bibliographic entry see Field 5G.
W89-08546

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* U. S. GOVERNMENT PRINTING OFFICE:1989-242-196:00,001

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1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

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1989 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

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N01	$55.00	E20	76.00
N02	55.00	E99	*

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Diskettes		*Magnetic Tapes*	
D01	$50	T01	$150
D02	75	T02	210
D03	125	T03	325
D04	175	T04	425
D05	225	T05	525
D06	275	T06	625
D07	325	T07	725
D08	375	T08	825
D09	425	T09	925
D10	475	T10	1,025
D11	525	T11	1,125
D12	575	T12	1,225
D13	625	T13	1,325
D14	675	T14	1,425
D15	725	T15	1,525
D16	775	T16	1,625
D17	825	T17	1,725
D18	875	T18	1,825
D19	925	T19	1,925
D99	*	T99	*

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